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Feasibility of Producing Synchronized Video Tapes as Instructional Aids in the Study of Music. Final Report.

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As an innovative aid to the study of music, recordings were made of musical performances and later synchronized with musical notations. To make the structures of the music more readily visible, and after experimenting with the use of staff notation, the author-developed "Nota-Graph" notation system was used. In this notation, there are three equidistant lines representing the same three notes in all octaves. Slides were made of the graphs and then 'scanned' by the camera. As in most of the other technical phases of the program, some degree of failure was experienced. This was considered unavoidable in a developmental effort. Production of similar videotapes by schools is considered possible if they have the equipment for it. In the near future, electronic video recordings can be fed into television receivers, making library checkout for home use possible. Evaluations by participants and experts are appended. They are favorable. (MF)

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FINAL REPORT
PROJECT NO. 7-I-052
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FEASIBILITY OF PRODUCING SYNCHRONIZED VIDEO TAPES AS INSTRUCTIONAL AIDS IN THE STUDY OF MUSIC

FEBRUARY 28, 1969

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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BUREAU OF RESEARCH

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Final Report

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Feasibility of Producing Synchronized Video Tapes as Instructional Aids in the Study of Music

George J. Skapski

San Fernando Valley State College

Northridge, California

February 28, 1969

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G.J.S.

COPYRIGHT INFORMATION

Production of certain materials needed in the course of empirical research described in this report has involved both publishing copyrights and mechanical reproduction rights.

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The "Nota-Graph" system invented by the author of this report is herewith released to the public domain, although its final formulation as an integral part of a comprehensive proposal to reform music notation will be subject to copyright.

*

SUMMARY

This study describes methods, systems, and procedures utilized for the purpose of recording musical performances and synchronizing their sound with related visuals of corresponding music notation or special graphs in the medium of video tape.

The interest in the potential of new medium, its possible application to music instruction, and conjectures about its relative advantages over other audio-visual media are revealed as primary reasons and motivations which have prompted the author to undertake this empirical research.

The philosophy guiding the selection of music literature for experimental pilot programs is formulated in form of pedagogical precepts. The successive presentation of fundamental principles involved in musical structure is believed to offer initial opportunities for an effective synchronization of aural impressions reinforced by visual perceptions.

Various modes of performing the same selection with either authentic or modern instruments, and also an occasional fragmentation of musical selections into their component structural parts, are devised as part of the emphasis on pedagogical objectives. Diverse methods employed in recording of musical performances are reviewed from frustrating beginnings to routine procedures.

Difficulties encountered in attempts to prepare a continuous copy of music notation and to synchronize it with the sound of music are stated as a partial justification of changing to slides production.

Production of graphs emerges as the most difficult and time-consuming activity in the preliminary stages of the project. Brief description of previous attempts at graphic systematization of musical sounds is followed by a detailed account of principles in-

volved in so-called "Nota-Graphs," the new system adopted for graphic diagrams. The horizontal bars of adhesive tape spread over the grids of graph sheets are being utilized to represent variations of pitch and duration.

Tests of feasibility in synchronizing notation or graphs with the sound of previously recorded performance are surveyed in terms of equipment used, procedures employed, and personnel involved. Some original plans are subject to abandonment or modification in the course of this experimentation. Some unexpected limitations of the recording equipment force re-orientation toward new methods. The relative advantages of applying special effects are also evaluated in light of their compatibility with the original objectives and with the programs' intended application.

Conclusions are based on comparative analysis of the quality and adaptability of the final product: a series of five videotaped pilot programs, from 25 minutes to one hour in duration, recorded on a one-inch, helical scan tape.

It has been found that synchronization is possible and that similar video tapes can be produced at school provided the necessary equipment is available. Otherwise, the professional recording studio may be chosen for recording sessions, and particularly for the editing of programs. The professional orientation of music personnel in recording procedures is most desirable, and vice versa, the familiarity of the studio personnel with music notation is almost mandatory for production of ideally synchronized programs. Video tapes may be produced either as "high band" or "low band" copies depending on their usage for broadcast purposes, closed circuits, or simple playbacks on the same machine which served for recording.

The pedagogic potential of graphic representation of pitches and durations seems to gain in significance after conquering initial reluctance to read within an unfamiliar system. Nevertheless, its application, at least in the present "Nota-Graph" form, appears to be limited to specific purposes of analytical study rather than compositional practice or performing activities.

Programs similar in contents to the pilot programs can be prepared for almost every level of instruction in music. Their suitability may be determined by following the same criteria which are used in selection of scores or other musical illustrations. Libraries of synchronized video tapes may permit the teacher to choose any program which fits his needs. The separation of programs into separate sections on performance, notation, or optional diagrammatic illustrations provides still further options for the instructor.

The final recommendation points to the unique opportunity of producing synchronized programs through the new process of Electronic Video Recording recently announced and demonstrated by the Columbia Broadcasting System, Inc. The possibility of feeding EVR films indirectly into any television receiver, opens consideration of home study and suggests manifold applications in the field of educational technology.

CHAPTER I

INTRODUCTION

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INTRODUCTION

Search for Integration of Sounds With Their Symbols

The dissatisfaction with the existing ways of presenting the sound of music in connection with its symbolization was the primary motivating force of this experimental research. Therefore, with the advent of the new audio-visual medium, this being video tape, the author was anxious to determine the relative advantages of the new medium over other audio-visual media for the purpose of instruction in music. It seemed reasonable to undertake the investigation of the potential of video tape in order to ascertain its advantages and limitations. This investigation would be specifically geared to determine the feasibility of producing a series of video-taped pilot programs in which the recorded sound could not only be preserved with the picture of the corresponding performance, but also be alternately synchronized with the moving picture of music notation or possibly with some graphic representation of pitch and duration for those unfamiliar with music notation.

Among inconveniences most frequently encountered by students of music is the inability of relating the actuality of sounds to the visual symbols representing them. Most of the well known library materials and audio-visual aids, with the exception of motion picture films, are deficient insofar that they present a static picture and demand special manipulation in order to correlate the sound of music with the corresponding portion or frame of the relevant image. Most transparencies designed for overhead projection, as well as slides, filmstrips, and microfilms, suffer from the same limitation. The opaque projection would demand the preparation of a special continuous copy to be rolled manually across the projection table besides obvious disadvantages well known to those who have used this medium of presentation.

Naturally, the motion picture offers the possibility of recording the sound and simultaneously filming pictures of music performance, notation or any graphic materials. However, the dependence on professional help in developing processes, the inability of instantaneous playback, and the impossibility of utilizing the same footage by magnetic erasure--somewhat limit the application of this medium in non-professional situations or in schools lacking in appropriate equipment. In addition, the magnetic sound recording should be used since the optical track seldom yields the tone quality obtainable by magnetic recording. Furthermore, conventional projection of motion picture films has always depended upon favorable conditions of viewing and screening and cannot be directly broadcast or distributed through closed circuits.

The opportunity of handling one, single source of recorded sounds and images for a particular music selection could provide a powerful tool and a convenient time-saving device in music teaching. Preparation of music materials for class presentation frequently demands advance reservations of divergent sources from various branches of libraries or other services and is often discouraging to instructors who are either unable or unwilling to transport volumes of collected editions and pounds of hardware to every class meeting. Particularly in crowded seminars, where the instructor needs commenting on but a few pages from several bulky volumes of music, the only alternatives are either to illustrate at the keyboard with students clustered behind the bench or to bring along the opaque projector, screen, phonograph with records, or a tape recorder with tape reels, everything well prepared and marked in advance. Whenever continuity is desired, someone must operate the sound equipment or keep turning the pages if the instructor is busy using the pointer or playing the piano.

Thus, the curiosity as to the possibility of utilizing the medium of video tape for recording and playback of visuals in synchronization with the sound of music has prompted the author, with interested associates, to undertake an empirical study by producing sample programs and evaluating their educational potential.

Selection of Program Contents

The intention of producing sample materials has inevitably led to the problem of selecting suitable excerpts from music literature. Their suitability would primarily consist of choosing such compositional practices which could best profit from analysis of the score or from highlighting their structural principles. Gradually, a plan emerged to organize samples of interesting compositions from the point of view of their increasingly more complex form.

The conscious limitation was to choose from the main stream of modal or tonal music so the examples would not prove too forbidding to anybody even casually interested in music. The guiding objective was to video-tape such scores whose sight would effectively complement the aural understanding. It was hoped that an attentive music student may thus confirm or extend his aural perception and occasionally discover the details of the sound image which otherwise might have been missed. The desire to explain the structural principle involved in a particular composition to a general student unfamiliar with the music notation resulted in devising special graphs focusing attention on the variation or identity of relevant melodic profiles and durational patterns. The hope was, again, to support the inexperienced ear with the observations of an otherwise idle eye.

Since the principle of repetition of melodic and rhythmic figures seemed as good a start as any, it was decided to unify the first pilot program by exemplifying the ostinato procedures as manifested in simple passacaglias. One of the most familiar examples was chosen to illustrate the strophic repetition of the bass line and the artistically exquisite counterpoint of the uppermost phrases. The other example was selected from another passacaglia which features a transposed reiteration of the bass profile in the middle of the composition.

The second program was to center around one example of a double canon. The canonic imitation was introduced here to further extend the principle of successive repetition, as met with in ostinato procedures, to the principle of concurrent repetition or imitation at transposed levels of melodic orders.

The principle of free imitation was to integrate the presentation of the third and fourth pilot programs, the first of them to treat the vocal idiom, the second one to illustrate instrumental textures. It was believed that points of imitation could provide an opportunity to clarify the melodic interdependence by watching the music score or its graphic analogue.

The choice of program contents has coincided with an emphasis on polyphonic textures within small media of undoubled vocal or instrumental parts. Perhaps this emphasis could be regarded as conducive to the major objective of the series which was to support and clarify the aural impressions. The logic of polyphonic textures has been usually more difficult to follow than one single line of melodic interest. Even students majoring in music have occasionally experienced difficulty in hearing several imitative or contrasting profiles in their simultaneity.

Soon after determining the scope of the experimental programs, it was possible to anticipate the construction of future programs, all of them featuring some new or extended principle of musical form. Since musical form follows its own logic, independent from verbal thinking, the entire project was viewed as the beginning of a whole series devoted to outstanding examples of compositional logic in music. The tentative title of this contemplated series was formulated as "The Principles of Artistic Logic in Music" which acrostically abbreviates to "PALM." Music compositions were to be selected as examples of the particular form or the foremost principle involved in their construction.

The integrative order of this future series was the view of music literature as representing different artistic solutions of expressing the musical thought without the referential or secondary attributes. It was believed that this type of emphasis could best serve the purpose of illuminating the workmanship of a composer and the aesthetic values of a composition. It was hoped that both analytical data and appreciative values would flow from the comparative study of application of one particular principle of musical logic to compositions from different historic eras, different geographic regions, and different artistic temperaments.

It was also assumed that highlighting the inner workings of that logic would present the music composition singularly free of irrelevant verbal transfers and thus eminently adaptable to any teaching situation. The formal order of a composition has always been an indisputable fact which can be heard in music performance or seen in music symbolization. If it does not necessarily explain everything, it offers complete freedom to interpret, evaluate or compare.

Thus, the dissatisfaction with the existing media of audio-visual presentation has led the author to consideration of the initial repertory and to the conviction that pedagogical interests will best be served if the new medium limits itself to the presentation of the sound and symbol of music reality without resorting to verbal commentary.

CHAPTER II

METHODS, SYSTEMS, AND PROCEDURES

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Recording of Musical Performances

The first three of the eighteen months allowed for completion of the project were spent on setting up the scope of preliminary investigation and on preparation of music for the first pilot program. The following two excerpts from Henry Purcell's opera Dido and Aeneas had been selected as musical material, henceforth to be referred to as Passacaglia I and Passacaglia II:

1) "Ah, Belinda, I am prest with torment"
   (designated as Song No. 2 in Broude Brothers
   reprint of the vocal score published by
   Novello Co., Ltd., London.)

2) "Thy hand, Belinda" followed by
   "When I am laid"
   (designated as Recitative No. 35 and
   Song No. 37, respectively, in the same
   edition.)

The familiarity of music audiences with these excerpts from the famous score, as well as the directness of this music's appeal, were thought to make it particularly suitable to serve as experimental material for the first program.[1]

In order to further enhance the program's historical perspective, each selection was prepared in two versions: one utilizing the modern string instruments, and the other played on replicas of old instruments such as quinton, treble viol, tenor, and bass viola da gamba. The lute served as accompaniment for the recitative preceding the aria "When I am laid," instead of the keyboard instrument.

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[1] Table 1, p. 57.

Both the harpsichord and the bass viol, reinforcing the viola da gamba or violoncello at a customary lower octave, accompanied throughout in both versions of each selection. The vocal part was also interpreted by one singer in both versions of each Passacaglia.

Unfortunately, the rehearsals had to be hurried, since the mezzo-soprano singing Dido's part was to leave for a longer association with the San Francisco opera. In lack of ready video recording equipment, it was decided to take scenes at school with a single motion picture camera on the 16 mm. film and record the sound on a 16 mm. audio tape. The unsatisfactory results of a later attempt to synchronize sound with picture while transferring the motion picture film and audio tape to video tape are described in the subsidiary report by the Technical Assistant.[2]

The experiences with the recording of the first pilot program have helped in planning of recording sessions for the originally contemplated two remaining programs. The renting of video tape recorders for a protracted length of time proved to be prohibitive in view of the fact that they could be fully utilized only during the recording sessions. Therefore, it was decided to prepare selections in school rehearsals and then arrange for recording them at a professionally equipped studio.

The second program was to revolve around a single selection, the first part of the celebrated motet for six parts by Josquin des Pres entitled "Veni, Sancte Spiritus."[3] In accordance with the general objectives previously explained in the introductory chapter of this report, the performance was designed to illustrate the polyphonic procedure of a double canon by "assembling" its imposing structure step by step. At the beginning only two voices participating in strict canonic imitation were to be heard. Then, in the following presentation, a free voice was to be added to this canon. Next, another canon for a set of two different parts was to be recorded. This, in turn, was to be followed by the same version with addition of another freely moving voice. The performance of the double canon without free parts was scheduled for the next performance, and finally, the entire texture with the independent parts weaving around the double canon was to be presented before cameras and microphones.

This time the performance was directly recorded on one-inch helical scan tape under the favorable conditions of a studio equipped with cameras, video recorders of high band capacity, microphones permitting mixtures, easily adjustable lighting, and several monitors in the master control room.

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[2] Tables 21 and 22, pp. 79 and 80.

[3] Table 2, p. 58.

The third program consisted of a chanson by Orlando di Lasso under the title "Le Rossignol" and two madrigals by Domenico Mazzocchi, "Fuggi, fuggi" and "Pian piano," all selected with one purpose in mind, to demonstrate the free imitation in the vocal medium.[4] There was no attempt to dissect the musical texture into its fragile components nor any plan to separate the successive points of imitation. It was hoped, however, that future synchronization of the audio portions of this tape with the picture of notation, and especially with the graphic representation, could possibly reinforce aural impressions and provide better insight concerning the delicate variations of fundamental phrases and motives.

The careful planning of the visual aspects of this program has paid off in better close-ups and in more variety in choice of pans. This marked improvement over the quality of the second program could have been attributed to longer rehearsal time on the set and to the increased responsiveness of the recording crew to the studio director's guidance. Otherwise, the program has been recorded under similar conditions to the preceding one.

There was no essential difference in recording of the fourth program of the series which was added later on for the purpose of experimenting with the synchronization of larger visuals rather than with the modes of visual presentation of the performance itself. The composition chosen for this recording was J. S. Bach's Sixth Brandenburg Concerto.[5] The authentic instrumentation of this composition could not be implemented in performance except for the use of one viola da gamba and a harpsichord. The sound track of this video tape was to serve for later correlation with the picture of the score in two versions, one leaving the basso continuo in its original linear form and the other one presenting the bass part fully realized for keyboard performance.

Preparation of Music Copy

After a series of meetings with the project's staff and invited consultants, it became clear that the major portion of the project's time would have to be devoted to preparation of graphic materials which were supposed to be video taped later on in correlation with the audio portion of the previously recorded performance. The production of these materials was divided into two separate activities--one of them aimed at preparation of the copy of conventional music notation and the other concentrated on a system of graphic notation which would help emphasize the structural significance of a given music example.

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[4] Table 3, p. 59.

[5] Table 4, p. 60.

With regard to music notation, the first idea was to cut up the music score into separate staff systems and paste them together to form a long ribbon of continuous notation. As the next step, either the copy would move in front of a stationary camera or the camera would scan the band of notation attached along the wall. However, this idea was soon abandoned in favor of making slides of music notation to be projected on the screen and recorded from there by video tape machines. The slides would be numbered consecutively, and then the odd numbers could be loaded into one projector and the even numbers into the other projector. Joining both projectors with a dissolving device which permits alternating projection could insure the continuity of slides on the screen. This technique was used for almost all pilot programs with certain undesirable effects described in detail in the next chapter dealing with findings and conclusions.

The reason for concentrating on slide production rather than on pasting together portions of the cut-up music score was a pragmatic one. Anticipating the lack of musical orientation on the part of the professional camera men, it was believed more practical to prepare for them specific portions of music copy, preselected in form of separate slide frames. The angle of the camera's horizontal pan could thus be reduced to the minimum. Besides, the fixed size of the 2" by 2" slides would relieve camera operators from constant adjusting of viewing frames. Furthermore, experiments with slicing of the printed score brought many frustrations due to the impossibility of separating staff systems with texts and dynamic or phrasing marks squeezed in the space between staff systems along the line of intended division.

The illusion of continuity could not be maintained in case when economy of printing had resulted in varying distances between staff systems of simultaneous sound reference. The changes of overall size and inner distribution of staff systems, so frequent in vocal or miniature scores, have virtually precluded a continuous ribbon of uniform width. The alignment of staff lines from page to page, or within the same page, would not pose any problems in some scores, as could be seen in the few excerpts reproduced from the score of Dido and Aeneas.[6] However, the noticeable break between measures 6 and 7 in the reproduction of Josquin's motet could serve as a rather typical example of problems most frequently encountered when attempting to align the staff systems.[7]

The best alternatives to insure consistent dimensions between the subsequent systems of staff lines would be, probably, to edit the entire score anew or to copy it in manuscript. Photographic enlargements or reductions would also cause changes in the size of notes and other symbols if the overall size would be insisted upon. Certainly, all these problems would simply disappear if a uniformly printed copy could be found among the collected editions or conductor's scores.

Production of Graphs

Problems of Graphic Systematization

The preparation of graphic copy consumed much more time than originally anticipated. The idea of substituting the conventional music notation with a series of lines or bars representing the successive changes in the value of pitch and duration of musical tones was not new with this author. In fact, it has been discussed for some time in books and articles concerned with the notational reform. It found its application in a remarkably original project of a French aviation engineer, and it became known as "Leyat's System" after the name of its inventor.[8] The graph method has also been proposed by Joseph Schillinger, and soon it became subject to ardent support or skeptic criticism.[9]

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[6] Figs. 11 and 12, p. 30.

[7] Fig. 13, p. 31.

[8] Paul Basiaux, "Nouvelle Ecriture Musicale; Le Systeme Leyat," La Nature, Vol. 60, pt. 1, (June, 1932), pp. 507-08.

[9] Joseph Schillinger, The Schillinger System of Musical Composition, New York: Carl Fischer, Inc., 1941.

Invariably, almost all of those proposals have tied the pitch space of the graphic representation either to the keyboard pattern or to the traditional five-line staff system. Consequently, such methods have resulted either in limiting the graph to the tablature system or in presupposing the knowledge of music notation. Even a recent system of graphic notation, developed by Donald Barra and called Sono-Graph, has related the pitch distance to lines and spaces of the music staff.[10]

Whenever the proposed systems relied on the graphic projection of pitch deprived of any reference level such as the keyboard or staff lines, they were justly criticized for many reasons. The major objection was the confusion experienced by any reader trying to differentiate and relate nondescript pitch levels uniformly spread throughout the vast field of the equally-tempered pitch spectrum.

Therefore, it seemed worthwhile to seek solutions which at least would alleviate the difficulties inherent in reading of nonreferential graphs or to probe in the direction of disassociating the chromatic pitch spectrum from the basically non-chromatic arrangement of traditional staff lines. Obviously, the visually equidistant staff lines do not determine equidistant pitch intervals as could be demonstrated by considering assignment of both treble and bass clefs to the same five-line system. The pitch interval between the first two lines in treble clef would spell a minor third, whereas a major third would be indicated by the deceptively equidistant second and third lines. This situation would become completely reversed by trying to read the absolute intervals symbolized by the same pairs of lines in the bass clef.

The "Nota-Graph" System

For this reason, the author has decided to apply the system he has devised 14 years ago as a by-product of his pedagogical activities. This system suggests the adoption of a two-line staff which is the result of the division of an octave into three, graphically as well as intervalically, equidistant spaces. The first and second staff lines correspond to the pitch levels of "E" and "G#" respectively, and the ledgerline, representing the pitch of "C", is added according to the need, this being analogical to the practice of the traditional notation. In a sense, the suggested staff is but an expansion of a thousand-years old idea to utilize both lines and spaces for pitch designation. This time, however, the space between the lines is again divided into three portions: one above the line, one below the line, and one "floating" between them. For pitches directly above or below the pitch of "C" (such as "C#" or "B") a ledger line may be added to the note head or to both ends of a graphic bar--in order to clarify the pitch level represented.

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[10] Donald Barra, Sono-Graphs Series 100, Selden, New York: Electra Publications, c1966.

The application of this staff for placement of note heads or diagrammatic bars has automatically eliminated traditional clefs, key-signatures, and accidentals. It also brought out the true pitch relationship, particularly in vertical sonorities. The only pitch reference needed for a two-line staff would be the assignment of the symbol for the octave register. This could be easily accomplished by appending letters with figures, or figures alone, in front of the staff system. The author has chosen the numbering of octave registers according to the system which assigns number "1" to the first complete octave at the bottom of the pitch spectrum. Following with subsequent numbers in ascending order, the octave extending between the so-called "middle c" and the "two-lined c" could be labeled with number "4". The choice of letters and numbers designating the seven octave registers was arbitrary and could be expressed in a different set of terms or symbols. In a sense, the symbol of octave register proved to be analogical in function to the traditional clef sign of music notation. In case of two or more staff systems needed to represent a wide pitch spectrum of a music score, a single symbol of octave register (preferably for the "middle c" or "C4" in this presentation) seemed to be sufficient. This single register symbol was all that was necessary to apply to staff systems representing a vocal composition. The vocal compass of any composition could be comfortably accommodated by four staff systems, the "middle c" being literally in the middle of the graphic representation. There was no need to repeat the register symbol on every new page or in the course of continuous graphic presentation. It was found that the eye could easily determine the absolute pitch levels without constant resorting to the "clef" symbol of octave reference.

The illustration of fundamental principles involved in conversion of conventional symbolization to the diagrammatical form, utilized in special graphs prepared for this project can be seen in the first figure of this report.[11] The product of this conversion was given the name of "Nota-Graphs," and was consistently applied in all presentations. The comparison of traditional staff lines with the staff of "Nota-Graphs" may also serve to underscore the hopeless incompatibility between the system based on diatonic principles and the system based on the principle of absolute equidistance along the vertical coordinate. The slightly larger distance between the lines and letters "T" and "A" of the word "STAFF" close to the left margin of the figure is representative of the only major third between "G" and "B" in the treble clef staff. On the other hand, the two major thirds found between the bottom two and the top two lines of the bass clef tend to expand the space between those lines and also the corresponding letters of the word "STAFF".

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[11] Fig. 1, p. 20.

The objective of this chapter is the description of methods employed to convert one system of symbolization into another one. The discussion of some advantages of the new systematization must be relegated to another place. It will suffice to mention, however, the unique opportunity this systematization offers to gain an unprecedented insight with regard to pitch relations, particularly in analytical work on contemporary and serial compositions. As mentioned earlier, the "Nota-Graph" system has been used initially for placement of note heads. The comprehensive treatment of the new pitch symbolization, coupled with an entirely new symbolization of durational values and a revised nomenclature of sound parameters, will be subject of a separate essay the author hopes to publish this year.

Preparation of Graph Copy

The production of graphs was predictably evolving through different stages of trial and error. Thanks to the assistance of two graphically talented graduate assistants, countless ribbons of illustrative materials were prepared in every conceivable format. The main objective remained to design such a format which could easily be video taped. Because the television medium does not tolerate complicated designs, the information had to be restricted to the simplest form and to the utmost legibility.

Fundamentally, the graphs were designed to show variations of pitch and duration at the expense of ignoring some relevant features, dynamics, quality, phrasing, etc. It was hypothesized that patterns of intervals and rhythm were sufficient to highlight the formal structure of a composition. An occasional reduction of all available parameters of pitch and duration to the most essential melodic profiles proved to be desirable under those circumstances. The correctness of this self-imposed limitation was borne out, later on, by the favorable comments of those professionals who knew how easily the television screen can be cluttered with irrelevant or illegible detail.

The choice of graph paper presented the first problem. The large size of green graph sheets, No. 47-1770, as manufactured by

The firm of Keuffel & Esser for the purpose of tracing security prices, was used for the first two pilot programs. Soon, after abandoning the idea of using india ink for tracing of lines and bars, the graph sheets, No. 47-0540 with 8 by 8 division to the inch, were adopted. Further usage of smaller grid pattern, chosen at first, was inconvenient due to the limited choice of adhesive tapes preferred over manual drafting of bars and lines. Special orders would have to be placed to insure sufficient variety of tape patterns in the width of 3/8 of an inch--the only size adaptable to the 20 by 21 division of the previously chosen graph paper. Since there was much greater variety of tape patterns in the easily obtainable size of 1/4 of an inch, the remaining graphs were produced on 8 by 8 grids, much more suitable for application of commonly used tapes.

Whenever the text was called for, pressure-sensitive white letters were rubbed off the commercially available cellophane sheets on the black surface of matte tapes. Tapes with glossy surface were reluctantly used since it was feared they may cause undesirable reflections when under strong illumination. The highly polished surface of glossy tapes proved less than satisfactory in the process of burnishing transfer symbols.

The later experience of video taping the first graphs convinced the technical personnel that white symbols tended to disappear or "shrink" when applied to the black background and viewed through television monitors. This optical disadvantage could also be noticed when glancing at the photographic reproduction of Figure 1. Every one of the black tapes bears a white numeral (from 0 to 11), and yet the eye can hardly perceive, much less distinguish, the shape of figures.[12]

A series of experiments with different sizes of letters did not improve the situation and led to a gradual elimination of white symbols on black background. Instead, the black text on light background was applied effectively. Letters were "boxed" inside of bars outlined by the black tape of 1/32" or 1/64" width. This method insured better legibility, albeit the time of production was slowed down considerably. The difference between the old method and the new procedures could be observed by comparing the legibility of white numerals in Figure 1 with the effect dark letters create on a light background in Figures 2-5 inclusive.[13]

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[12] Fig. 1, p. 20.

Ocassionally, the intricate, many-voiced texture of music demanded sufficient differentiation between the vocal parts or the thematic material. This differentiation in black and white could only be implemented by selecting tapes of contrasting patterns, usually applicable to statistical charts. The use of such tapes, however, virtually precluded the transcription of texts, since neither white nor black symbols could be satisfactorily deciphered when superimposed on striped or cross-hatched background. The preparation of graph copy for the second pilot program has presented problems of this nature. The text had to be left out lest the density of graphic configurations failed to convey the clear profile of a double canon. Admittedly, the text would assist in recognizing the points of canonic reference--yet it could be used only at the risk of obscuring relevant profiles.[14]

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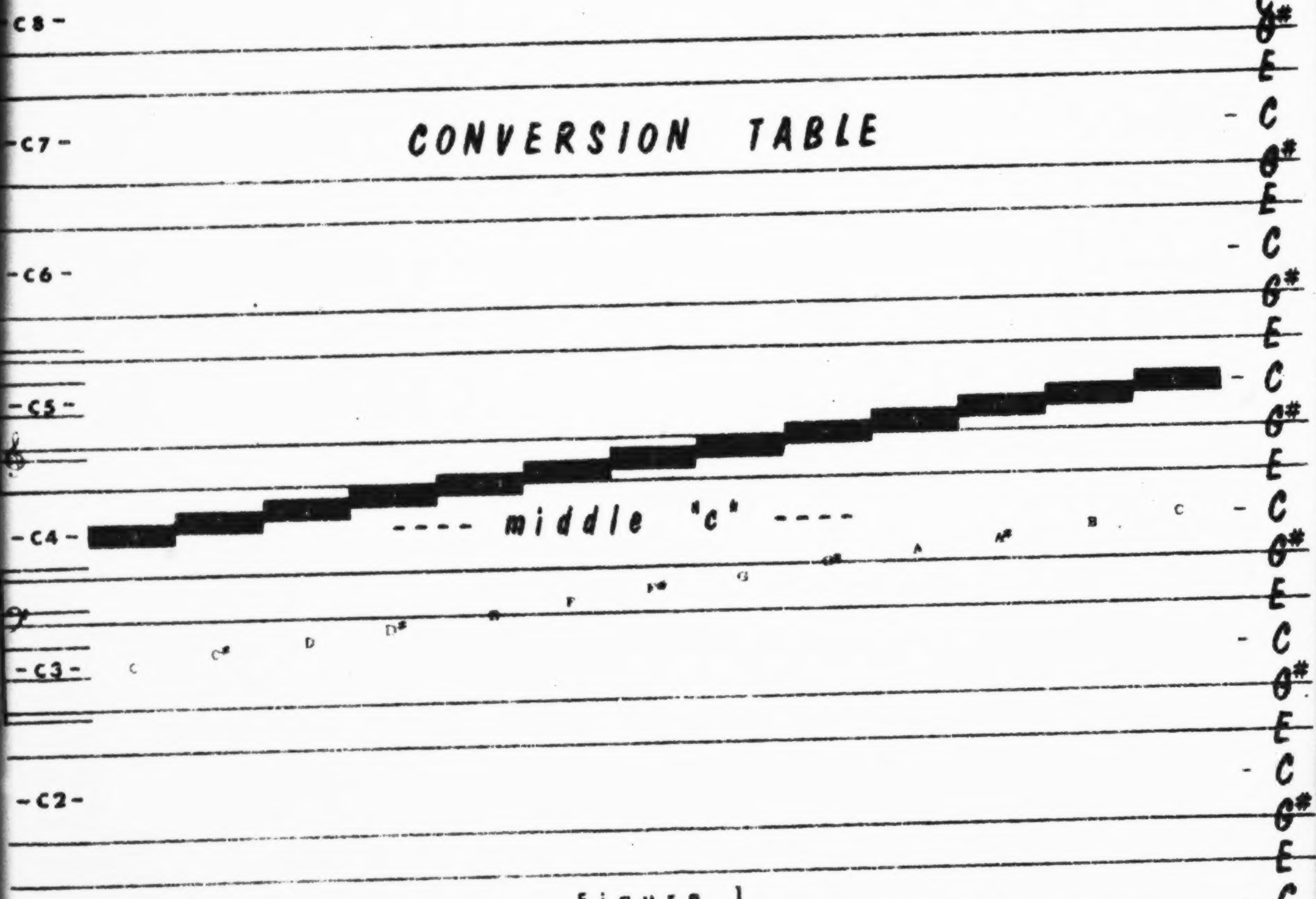
[13] Figs. 2-5, pp. 21-24.

[14] Figs. 6-7, pp. 25-26.



CONVERSION TABLE
-C8-
-C7-
-C6-
-C5-
-C4-
-C3-
-C2-
-C1-
middle "c"
C
C#
D
D#
E
F
F#
G
G#
A
A#
B
C
C
G#
E
C
G#
E
C
G#
E
C
G#
E
C
G#
E
C
G#
E
C
G#
E
C

Figure 1
Conversion of Pitch Classes from Traditional to NOTA-GRAPH Notation

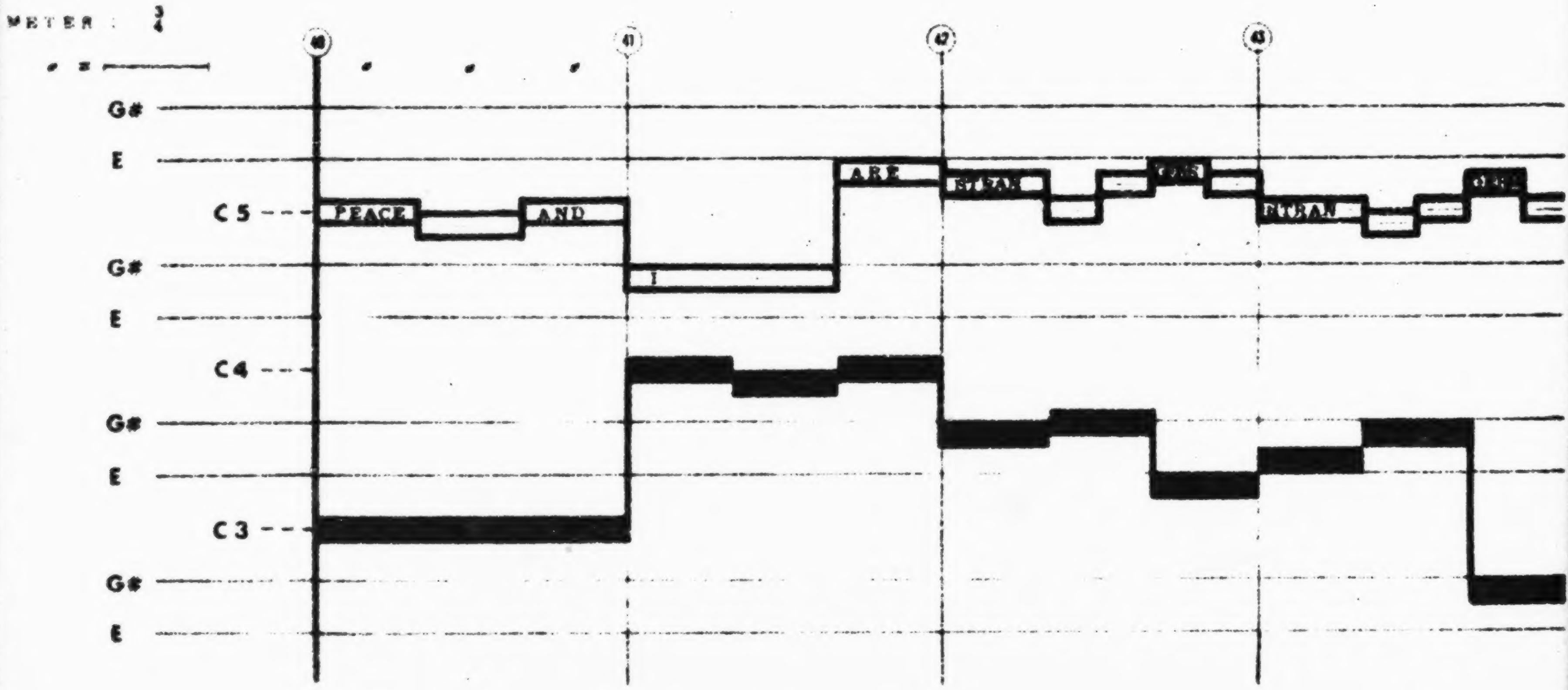

METER : 3/4
40
41
42
43
G#
E
C5
G#
E
C4
G#
E
C3
G#
E
PEACE
AND
I
ARE
STRAN
GER
STRAN
GER

Figure 2

"Ah! Belinda" from Purcell's DIDO and AENEAS in NOTA-GRAPH (measures 40-43)

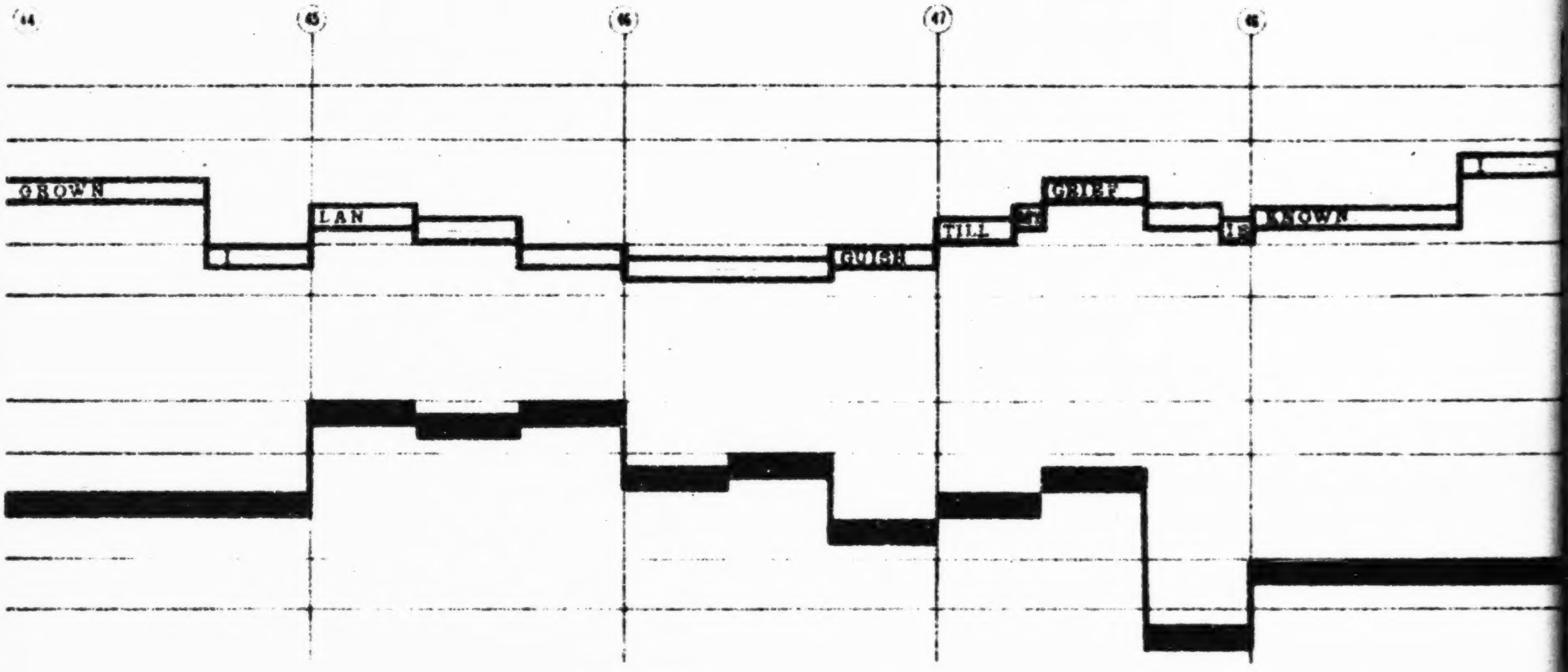

44
45
46
47
48
GROWN
LAN
GUISH
TILL
GRIEF
KNOWN

Figure 3

Fig. 2 cont. (measures 44-48)

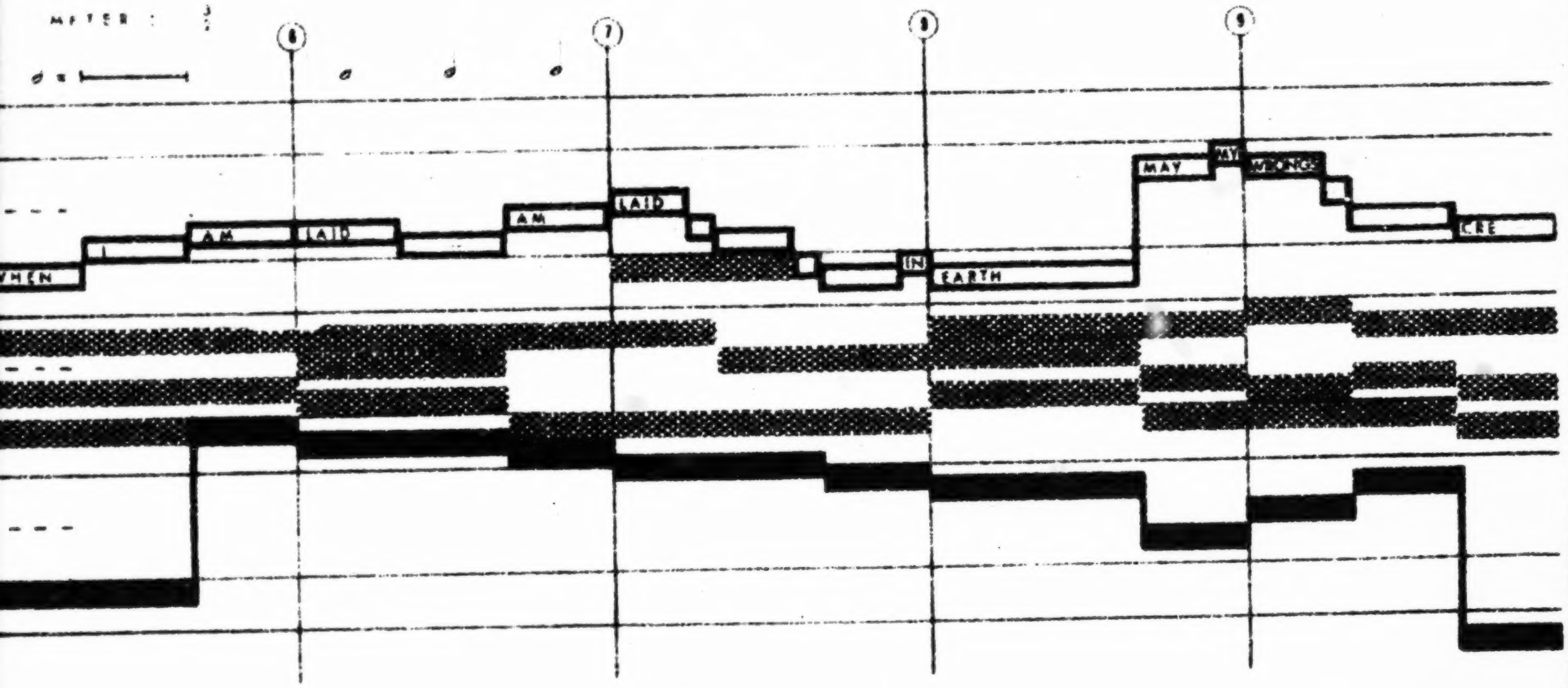

METER : 3/2
6
7
8
9
WHEN
I
AM
LAID
AM
LAID
IN
EARTH
MAY
MY
WRONGS
CRE

Figure 4

Dido's Lament from Purcell's DIDO and AENEAS in NOTA-GRAPH (m. 5 - 9)

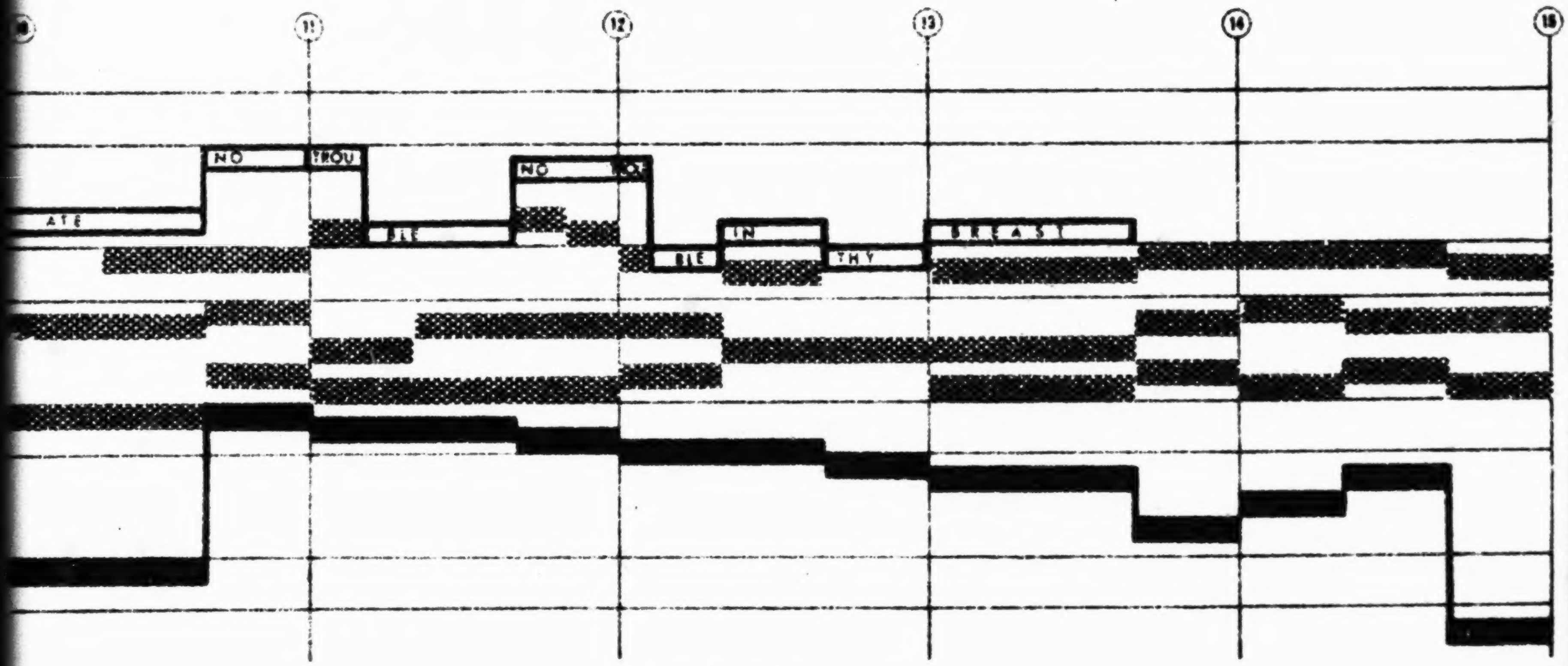

10
11
12
13
14
15
ATE
NO
TROU
BLE
NO
TROU
BLE
IN
THY
BREAST

Figure 5

Fig. 4 cont. (m. 10 - 15)

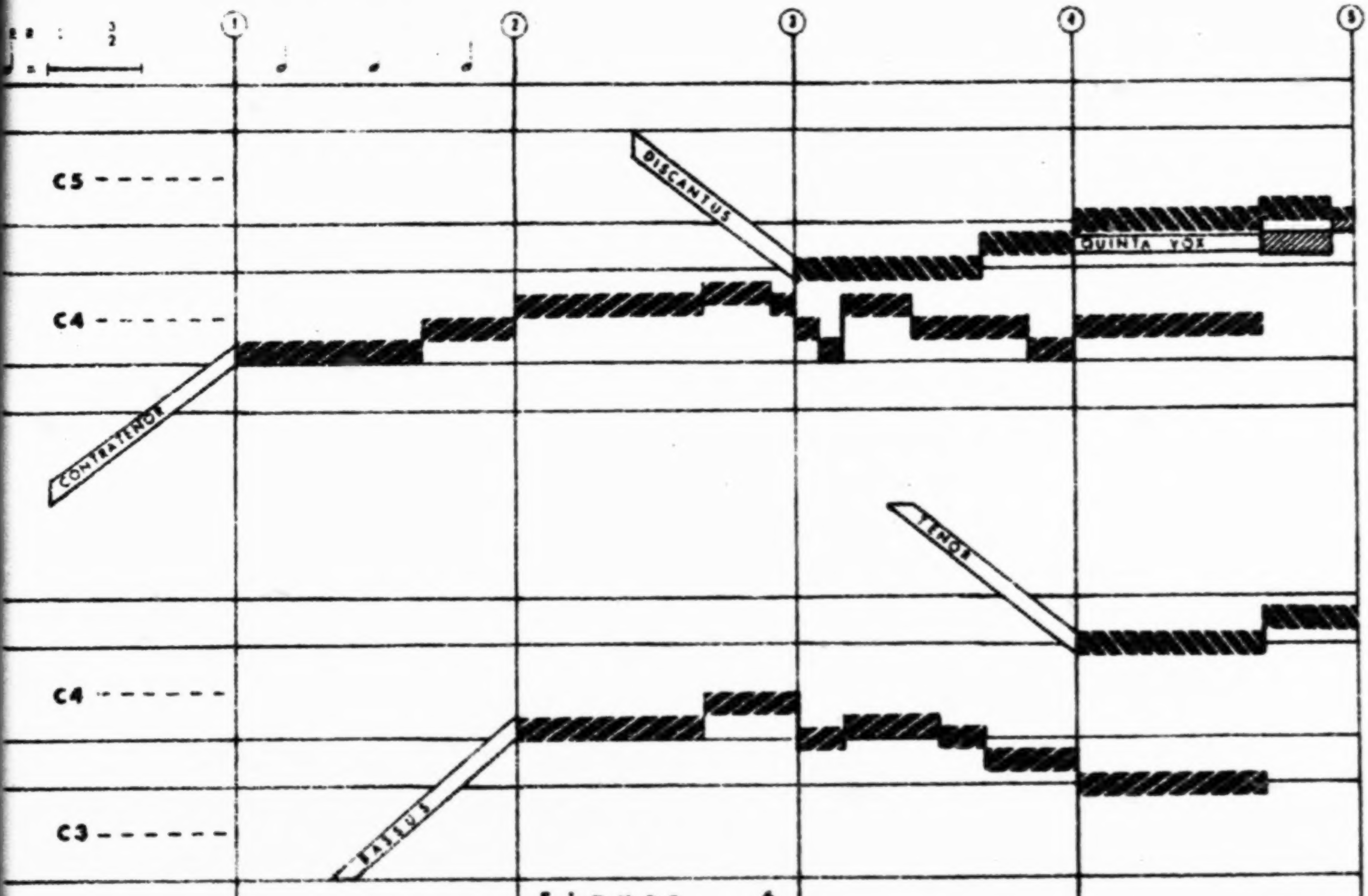

ER : 3/2
1
2
3
4
5
C5
C4
C4
C3
DISCANTUS
CONTRATENOR
QUINTA VOX
TENOR
BASSUS

Figure 6

itial measures from Josquin's VENI, SANCTE SPIRITUS in NOTA-GRAPH

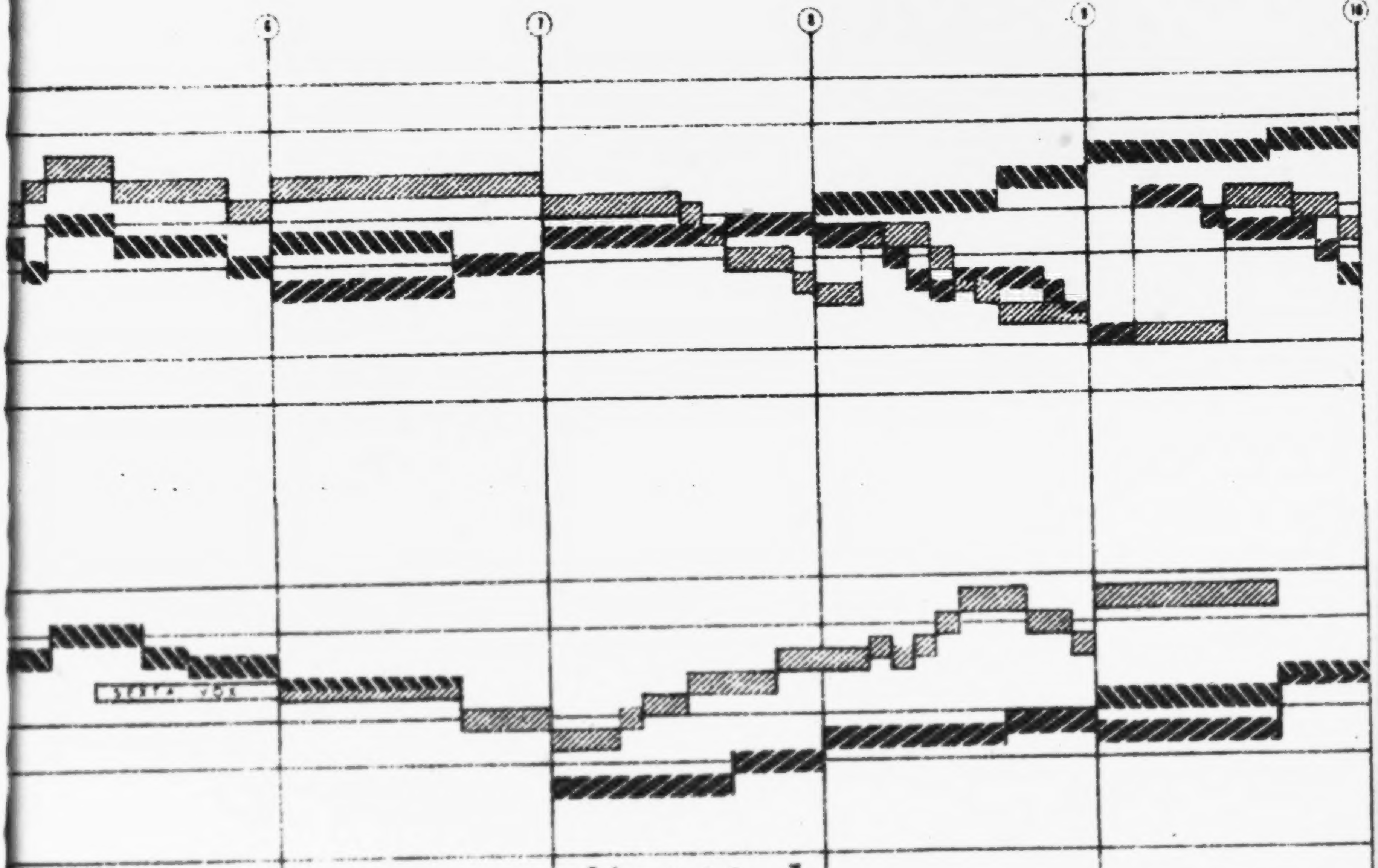

6
7
8
9
10
SEXTA VOX

Figure 7

Fig. 6 cont. (meas. 5-9)

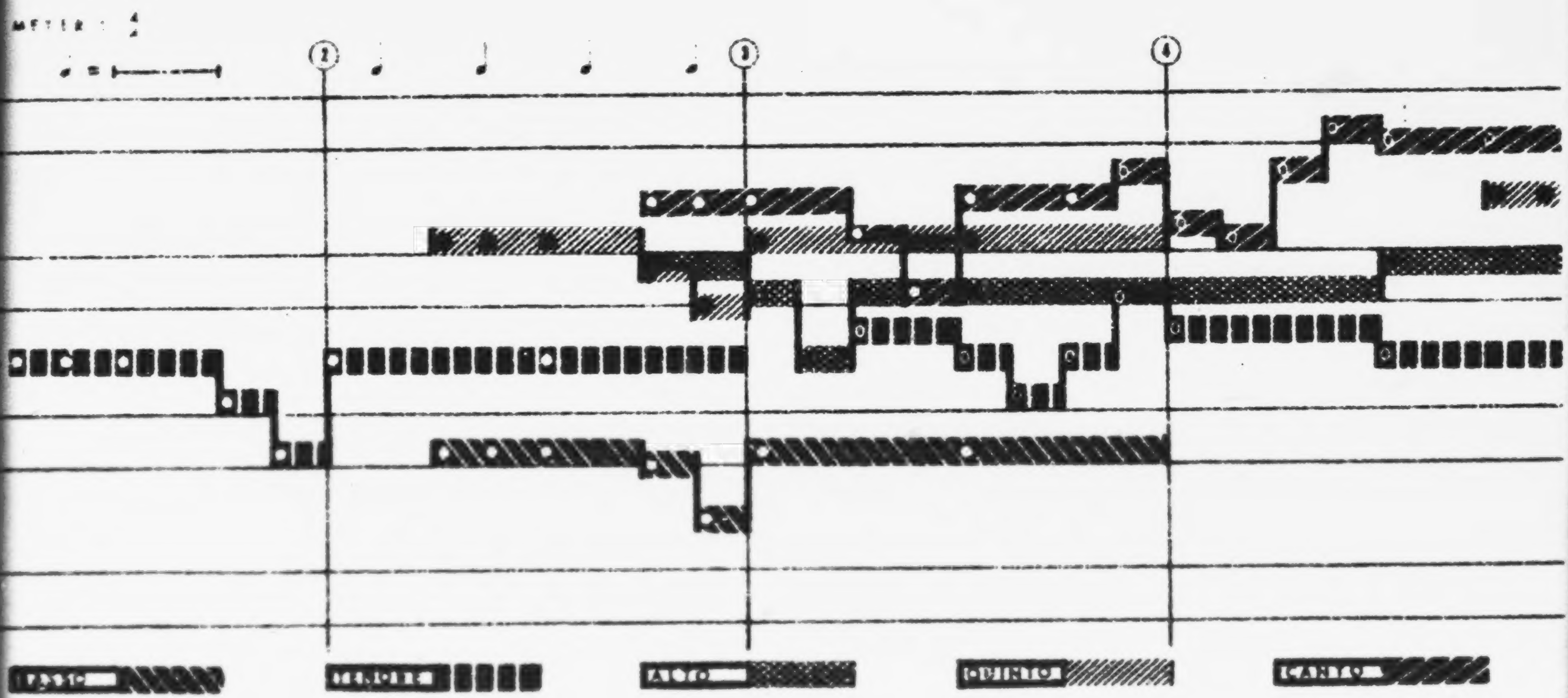

METER : 4/4
2
3
4
BASSO
TENORE
ALTO
QUINTO
CANTO

Figure 8

The Beginning of Mazzocchi's "Fuggi, Fuggi" in NOTA-GRAPH

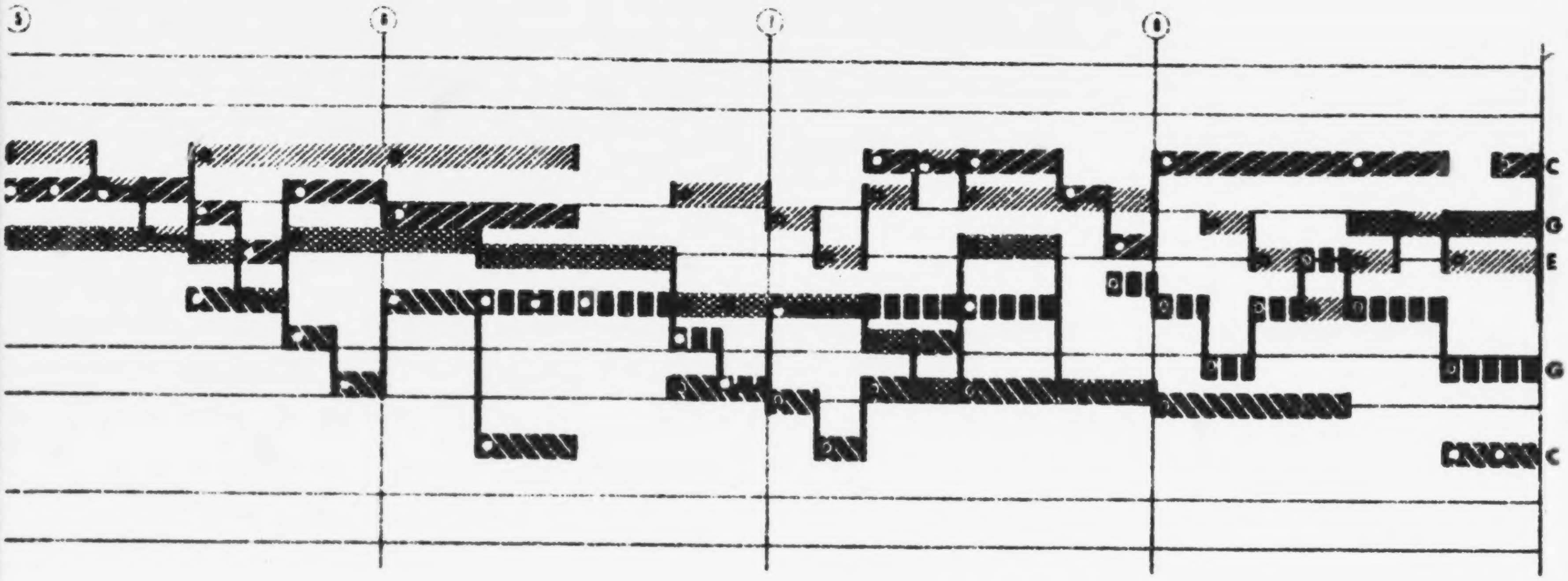
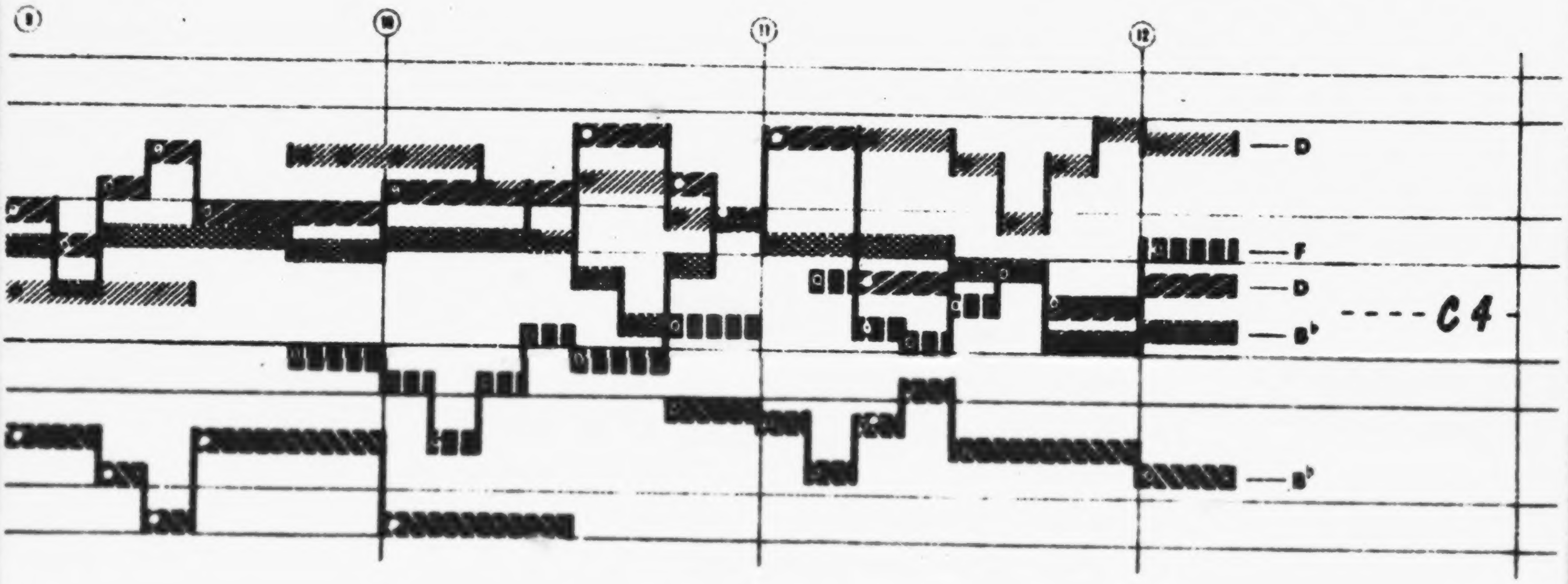


Figure 9

Fig. 8 cont. (meas. 5 - 8)



9
10
11
12
D
F
D
B♭
B♭
C4

Figure 10

Fig. 9 cont. (meas. 9 - 12)

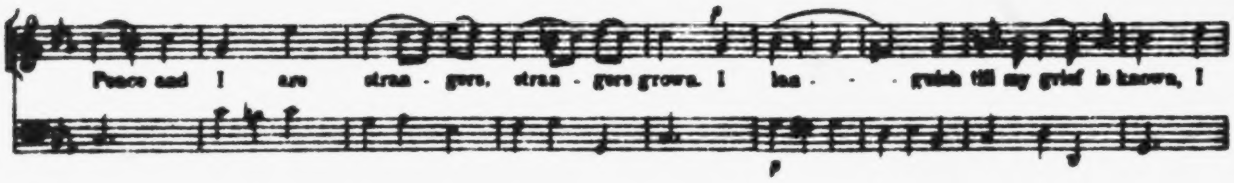

Peace and I are stran - gers, stran - gers grown. I lan - - guish till my grief is known, I

FIGURE 11

"AH! BELINDA" FROM PURCELL'S DIDO AND AENEAS IN TRADITIONAL NOTATION (M. 40-48)
Reproduced from Dido and Aeneas by Purcell by permission of Novello & Co., London.(B.B. 221)

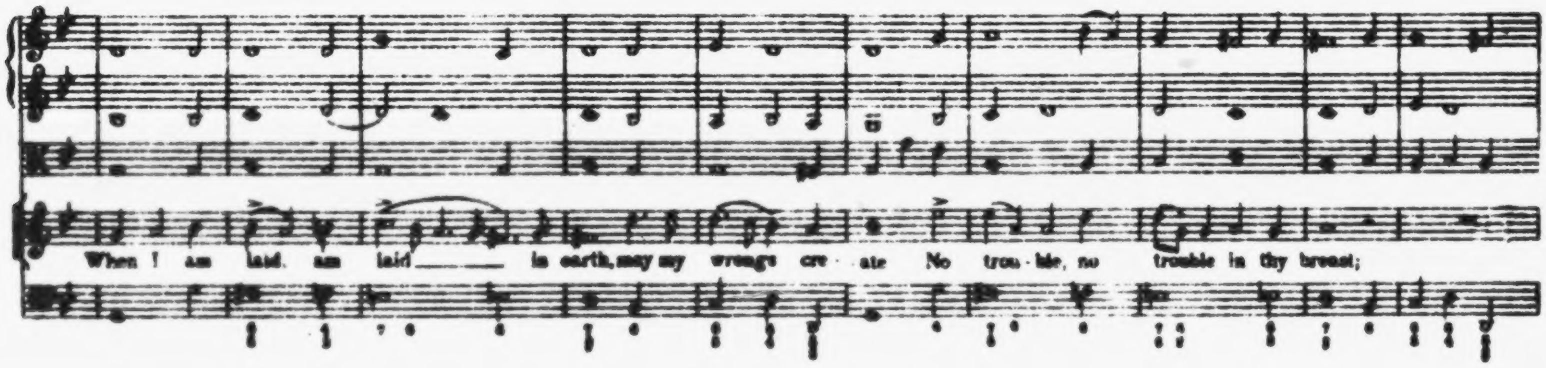

When I am laid, am laid in earth, may my wrongs cre - ate No trou - ble, no trouble in thy breast;

FIGURE 12

DIDO'S LAMENT FROM PURCELL'S DIDO AND AENEAS IN TRADITIONAL NOTATION (M. 5-14)
Reproduced from Dido and Aeneas by Purcell by permission of Novello & Co., London.(B.B. 221)

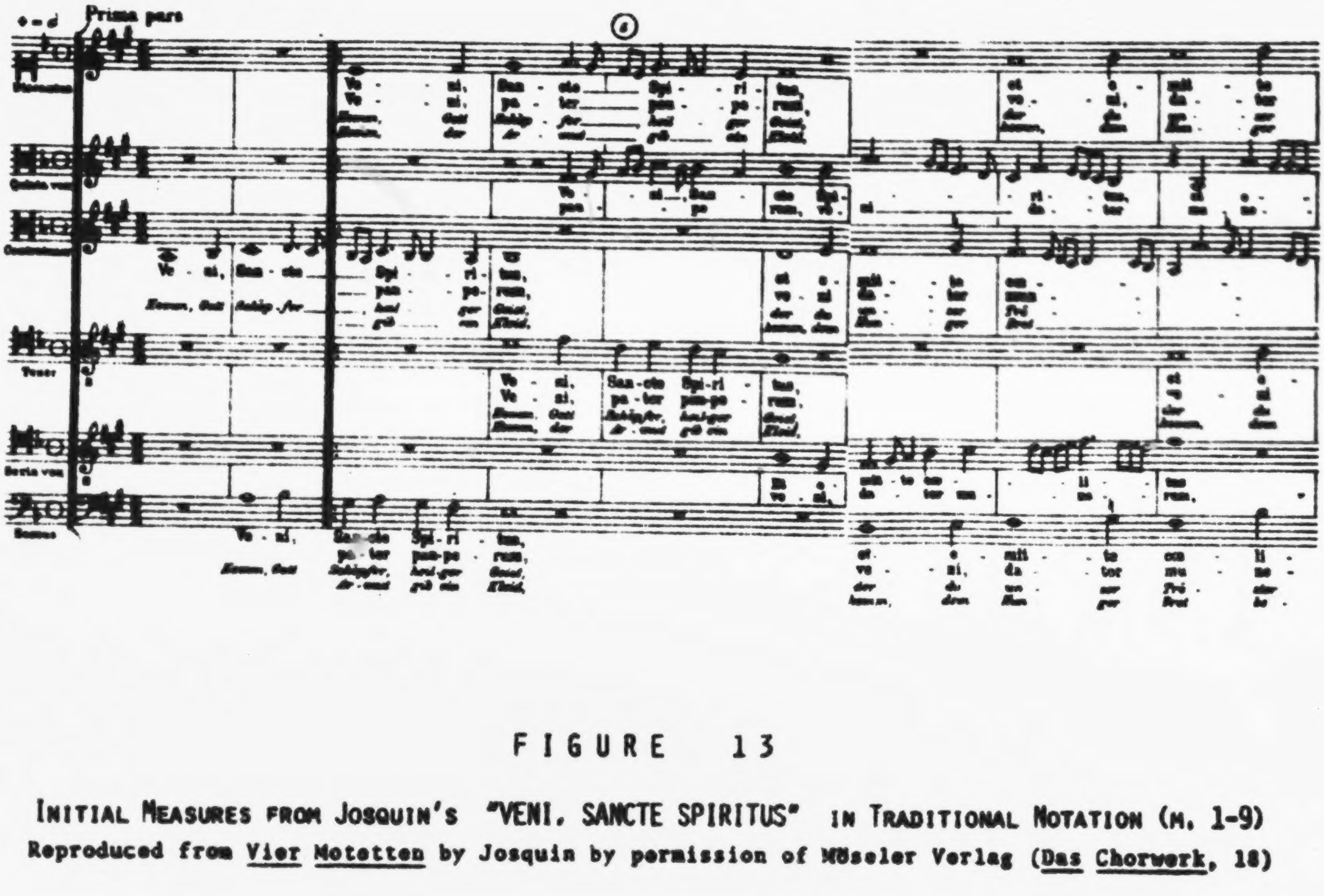

Prima pars
Discantus
Quinta vox
Contratenor
Tenor
Sexta vox
Bassus
Ve - ni,
San - cte
Spi - ri - tus,
Kumm, Gott Schöpfer,

FIGURE 13

INITIAL MEASURES FROM JOSQUIN'S "VENI, SANCTE SPIRITUS" IN TRADITIONAL NOTATION (M. 1-9)
Reproduced from Vier Motetten by Josquin by permission of Möseler Verlag (Das Chorwerk, 18)

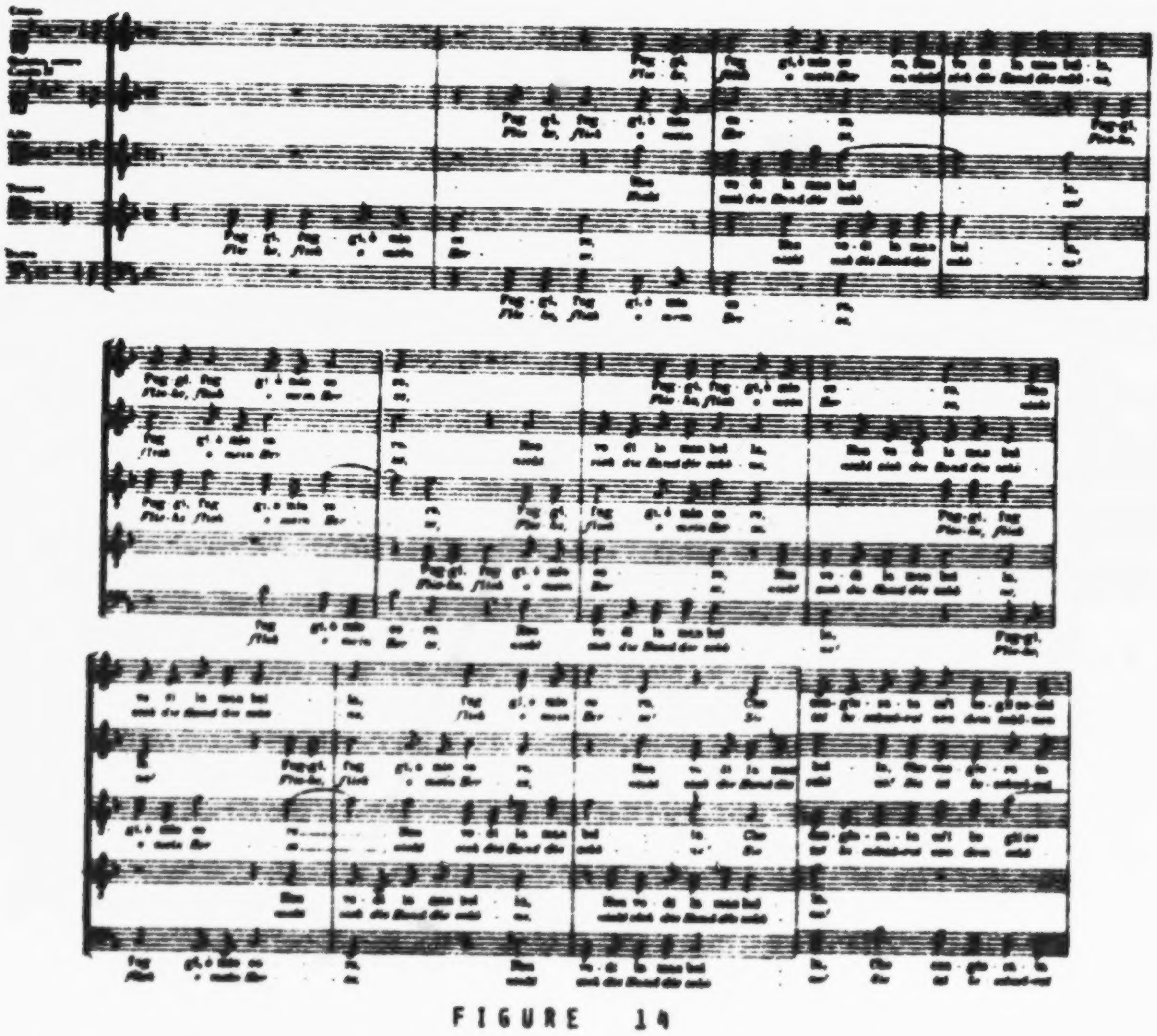


FIGURE 14

The Beginning of Mazzocchi's "FUGGI, FUGGI, O MIO CORE" in Traditional Rotation (m. 1-12)
Reproduced from *Sechs Madrigale* by Mazzocchi by permission of Möseler Verlag (*Chorwerk*, 95)

FIGURE 15

(Original Copy Only)[15]

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[15] For monochromatic reproduction, cf. Appendix A, p. 53.

FIGURE 16

(Original Copy Only)[16]

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[16] For monochromatic reproduction, cf. Appendix B, p. 54.

FIGURE 17

(Original Copy Only)[17]

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[17] For monochromatic reproduction, cf. Appendix C, p. 55.

In case of repeated articulations of the same pitch, it became mandatory to separate those distinct articulations from each other. Small dots and circles were tentatively applied to the surface of statistical tapes with questionable results. The distracting variety of tape patterns and superimposed symbols of articulation tended to draw the mind away from the primary aim of perceiving and identifying the interrelated profiles of structural significance.[18] In this regard, however, the difficulty experienced by a reader of the diagram would have to be compared with the usual inability to recognize significant patterns and their tonal level by reading the printed score.[19] Any attempt to simplify the graphic texture by printing the text either above or below the bars met with further confusion rather than clarification of the total design. Actually, this problem was never solved to the full satisfaction until the idea of color differentiation has opened new vistas.

Color Tests

The employment of color tapes has permitted to differentiate the parts of a composition, and at the same time, to print black letters on lighter colors or even white letters on colors of deeper saturation. The related profiles of color bars could still be compared with relative ease. Moreover, rhythmic articulation on the same pitch level could be depicted by the placement of text syllables. Similar separation in instrumental music could be marked by light vertical lines across the width of the tape bar.

The color presentation would automatically involve use of special equipment for video recordings and playbacks. The prohibitive cost of renting such equipment forced the abandonment of any plans for producing even a short pilot program in color. Nevertheless, a partial color graph of one of the selections used in the third program was hastily prepared and briefly tested by recording it on video tape produced by the Minnesota Mining & Manufacturing Company. The camera used was Model No. 2970, and the video recorder was Model No. 2921, both produced for Bell & Howell Company by the International Video Corporation. The results were evaluated on the 23" Miratel monitor, a product of Barl Brothers.

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[18] Figs. 8-10, pp. 27-29.

[19] Fig. 14, p. 32.

The color tapes used for production of graphs were those manufactured by the Chart-Pak Corporation. The same manufacturer's product was also used in case of black or statistical tapes.

The beginning of Mazzocchi's short madrigal "Fuggi, fuggi o mio core," the central selection of the third pilot program, was chosen as a test case for experimentation with color. It was anticipated that color could be effectively used to emphasize the intricate relations between the highly imitative motives of this selection. For this reason, the testing sample was prepared in such way that each one of the participating vocal parts was assigned the darker hue of an arbitrary color to one phrase member, and the lighter hue of a similar color to the other phrase member. Thus the technique of imitation could be perceived by viewing contrasting or related melodic profiles with the help of contrasting or related colors.

The color testing sample was constructed similarly to the black and white graph, the beginning of which appeared in Figures 8 through 10. The full impact of the comparison between the black and white graph, and its color version, can be realized by consulting Figures 15 through 17 of the original copy of this report.[20] Multiple copies of the same figures could not be reproduced in color. However, colorless reproductions of those figures have been appended to every copy of this report. For obvious reasons they are but poor substitutes for the originals, since they barely suggest the vivid contrasts of color differentiation by the poorly contrasted, relative "gray scale."[21]

The methods of recording color "Nota-Graphs" did not differ essentially from the previous procedures in recording black and white pictures. The graph roll was mounted on the provisional "crawler" and unwound in front of the camera in the same way as was the case with other graphs. Except for some minor differences in lighting, distance, and camera adjustments, the general conditions remained the same. The surprising findings with regard to the camera's reaction to a dozen of tentatively chosen color variations--will be touched upon in the next chapter.

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[20] Figs. 15-17, pp. 33-35.

[21] Apps. A-C, pp. 53-55.

Synchronization Procedures

Notation with Sound

The exact correspondence of sounds with notational symbols was the chief concern of attempts at synchronization. It soon became obvious that this was easier in theory than in actual practice. The movement of the camera has emerged as the most critical element in attempting precise correlation. The camera operator was helped by verbal advice of an assistant, who read music fluently and kept the eye on the monitor. At the same time the assistant was operating the dissolving switch of the device connecting two Kodak Carousel projectors. This special device has permitted forwarding the next slide immediately after the music on the preceding one has run its course.

Sometimes, the camera operator was able to scan the slide from left to right; at other times, he had to move it to the next lower portion of staff systems, if necessary. Much skill was needed, of course, in rapid backing of the camera to the left margin while slides were overlapping or when the next lower portion was to be recorded. No less attention was required from the assistant who had to compensate for a certain time lag involved in operation of the dissolving control. The projector's mechanism needed approximately two seconds to complete its cycle at every change of slides. This amount of time had to be anticipated by the assistant in charge of the slides projection. The forwarding button had to be pressed in advance of the next slide by taking into consideration the tempo of music. Occasionally it happened that the image was cut off prematurely, or the next slide was received too late for comfortable reading. At some recordings it was advisable to help the camera man with a projection pointer showing a small-sized arrow above the relevant portion of the projected image. This technique was particularly needed whenever text syllables were missing in the purely instrumental medium.

The first source of sound was the previously recorded music performance. The second source was a specially prepared audio tape with recorded narration of the titles or of an occasional brief commentary. The titles were prepared in form of slides made from photographing short inscriptions type-written on standard cards of 4" by 6" size. Title slides were then distributed inside of the slide drums at appropriate places between the notation slides. The technical assistant's responsibility was to keep the narrative portions of the audio tape "cued" to the corresponding slides and to feed the audio signals when required.

The professional studio operator was in charge of two Ampex video recorders. One of those recorders has supplied the playback of the audio portion of music performance. The other one was intermittently recording the pictures of music notation, as received from the camera, with the occasionally needed sound of narration, as received from the tape recorder. Special assistance proved necessary to handle separate input or output controls for volume, quality, etc. Those auxiliary duties had to be performed by additional studio personnel because the ordinary operators were already overextending themselves in responsible assignments.

The difficult task of correlating all those activities fell to the recording director. He not only controlled all the signals at the mixing control, but also had to supervise the operation of playback and recording machines. His responsibility involved split-second anticipatory "cueing" and electronic edition. Most of the programs were recorded as so-called "high-band" masters capable of superior resolution and permitting broadcasting through normal television channels. Those master reels were dubbed, later on, as "low-band" copies, to permit playbacks on video recorders other than the professional Model No. 7800.

The amount of time demanded by such recording sessions exceeded the most generous calculations. Although the axiom of video recording allows at least the ratio of 1:10 between the length of time spent on recording, and the timing of the edited product--it was often experienced that those estimates had been rather conservative. Particularly, all the preliminary activities involving all the "setting-ups," "dry-runs," adjustments of the recording equipment, countless delays caused by mechanical failures, etc. took more time than the actual recording of synchronized signals.

The idealistic time calculations attached to production lists--which every cooperating studio operator had received in advance--

became progressively trimmed to much more realistic figures, as recording sessions went along. The lists of production synchronization were actually more elaborate than those represented in the tables accompanying this report.[22] The lack of adequate space in the format of this report made it mandatory to omit specific references with regard to selection of "takes" and scenes from the master tapes of music performance. Figures and symbols pertaining to the footage and timing of component signals proved indispensable in the heat of frantic activities involving sometimes a dozen of people spread through the master control room and the adjoining studios. Most of the production staff had been communication professionals, but some of the program staff were novices, compensating the uncertainties of empirical approach with overabundance of zeal and dedication.

Graph with Sound

The recording of graphs in synchronization with the audio portions of the related music performance has followed similar principles to the merging of notation with music. The earlier procedure of picking up the image of graph through a "Tel-Lectern" has been changed to direct coverage by a motionless camera. The reason for this change had to be attributed to some unexplained technical failures within the system of electronic "sync" generation.

The successively joined graph sheets, in form of a continuous band of 10" or 12" in width, were rolled up on wodden dowels, and then stretched across the projection table of an "Apollo 6" overhead projector, manufactured by the American Optical Company as Model No. 3651. By placing the projector on its side and by manual cranking of the take-up roller, it was possible to move the copy in front of the camera. Although such a make-shift device was no substitute for a professionally used "crawler," it served its purpose remarkably well, not without some minor frustrations.

The synchronization with music did not present serious problems, since the camera was stationary and the graph was moved by the same assistant who also has helped in preparing most of the graphs used. Being familiar with the graph design and fixing his eye on the imaginary center line of the monitor set, he was able to forward the copy in correspondence with the playback of music heard from the master tape.

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[22] Tables 6-10, pp. 63-67.

Plans for renting of a "crawler" with electrically controlled speed never materialized. It would be too difficult to speculate whether or not such a device could be of any advantage. Although some jerkiness in motion of the graph copy could be noticed at times, this handicap could be eliminated by more practice.

Application of Special Effects

No experimentation would be complete in the field of television without an attempt to employ all the familiar special effects, so readily available and so effectively used in this medium. The fifth, and last, pilot program of this series was devoted to this purpose. As the program contents shows, there was no new material used. The previously edited four pilot programs served as the source material for a composite program.[23] The originally prepared list of production synchronization could not be followed during the recording sessions, because the available equipment had not always permitted the direct feeding of recorded signals into the mixing control.[24]

Mixing notation and graphs with the picture of corresponding performance suffered under technical limitations which precluded recording the mixture of two component signals as received from two playbacks. Signals had to be routed via the camera, in order to be merged at will through the editing console. Therefore, cameras had to be set up again in front of two 9" Conrac monitors which showed playbacks of those portions which were supposed to be intermittently combined and recorded on a new reel. For example, one of the video recorders (VTR 1 or Master) would play the performance portion of a certain selection, while the other recorder (VTR 2 or Dub) would retrieve the graph portion of the same selection. Cameras had to relay the monitor pictures to the master control where they appeared on control monitors, thus permitting the editor to choose whatever seemed appropriate for application of special effects.

The source of sound was optional; it could have been drawn from either of the two playback recorders. However, assistants operating those recorders had to cue the beginnings of the related portions by split-second timing, in order to secure perfect synchronization. This was done by ear, first establishing the meter readings of the points where audio signals coincided with each other, and then by backing both tapes for the same abount of footage. In this manner, tapes were prepared for simultaneous starts, well ahead of the section to be recorded. This procedure was necessary because some of the titles or commentary had to be recorded from one playback only, while the other ran "blindly" and "silently". Punching the starting button of the other recorder while the first one was already in operation--would amount to a "hit-and-miss" procedure with little chance of success in synchronization. Besides, it would prevent the editor from seeing the other program in advance. The editor would have to anticipate the moment of appearance of the other program, should he have decided to record it from its very beginning.

---

[23] Table 5, p. 61.

[24] Table 10, p. 67.

The techniques of utilizing special effects involved arbitrary superpositions of one picture over the other one, splitting the screen horizontally or vertically, and also opening or closing rectangular masks from either corner of the picture. The interest in variety and general aesthetic appeal of the picture, had motivated the editing director in selection of excerpts from separate sources and in application of mixing effects. At times, the picture of performance would appear as the slightly dimmed background to the picture of notation in foreground. On other occasion, the solo singer would be seen in the upper-corner inlet of the unfolding graph. Similarly, a viola-da-gamba passage could be shown juxtaposed with the close-up of the relevant portion of the graph or notation.

The potential for unlimited variety of mixtures notwithstanding, there was a feeling of misgiving on the part of this writer concerning the possibility of over-editing, and thus limiting the application of what originally was intended as a series of integrated, modular programs rather than arbitrarily preselected mosaic of scenes with entertainment appeal. There was also dissatisfaction with the over-all quality of the composite program, mostly due to the distorted quality of pictures. This was unavoidable and predictable in a situation where the program sources were many times removed from the original source. For instance, it should be remembered that the final picture of notation in the composite program was recorded from the picture appearing on one of the Conrac monitors. This picture, in turn, was the playback of camera's view of slides. The slides themselves were but the photographic reproduction of the original. No wonder that the end product suffered from blurred focus, improper alignments, cut-off margins, keystone distortions, and all other imperfections, multiplied by the amount of "generations" involved in the transfer.

All those objections and observations properly belong into the sphere of evaluation rather than description of methods and procedures. Therefore, the subject of this concern will be treated again as part of findings and recommendations in the next chapter.

CHAPTER III

FINDINGS AND RECOMMENDATIONS

CHAPTER III

FINDINGS AND RECOMMENDATIONS

Technical Facilities

After completion of all experiments, it was generally felt that the central thesis of this project was proved satisfactorily. The synchronization of sound with pictures of music performance, notation or graphs, was found to be feasible. The quality of the finished product depended mostly on technical facilities, time limitations, and budget restrictions.

With regard to technical facilities, it was found that studio recording was preferable to renting equipment for recording at school. It was realized that this situation would be different in schools which could afford owning the necessary equipment. A compromise was possible to combine recording at school with editing in the studio. Much would depend on whether or not programs were devised to be broadcast, sent by closed circuits, or played back through the same equipment on which they had been recorded. Producing tapes of broadcast quality would demand use of special machines, whereas "low-band" programs could be taped on many, less expensive recorders.

Contrary to initial expectations, the video recording and playback equipment was found to be unreliable at times. This could range from strange feedbacks, resulting in distortion of input signals through unexplained camera malfunctions, to unexpected failures of relay systems. Under certain circumstances, tapes would suffer from disturbing picture "noise", or would drop the pitch level of audio signals a few seconds after the input was connected from an outside source. The alertness of the studio personnel has prevented most of technical failures, although many reasons for strange behavior of manifold circuits had to remain unexplained.

The reproduction of sound quality was far better in the professional studio when heard through an adequate amplifier system and large responsive speakers. It would deteriorate, however, when played through some of the smaller models of video recorders. Even the most careful recording of sound through the best microphones available would go to waste, if reproduced through the system incapable of doing justice to the original frequency range. It was regrettable to conclude that sound has still remained the step-child of the television industry.

Recording and Synchronization

All musical selections utilized in this project were performed "live" in front of the cameras. Not all scenes and "takes" were acceptable for editing. It took sometimes several recordings before one of them was selected for inclusion on the master tape. First programs were poorly planned with regard to the visual interest. Severe time limitations and lack of appropriate equipment were partially responsible for some inadequacies. The ideal situation would require a perfect familiarity with music on the part of the recording personnel. No amount of printed or verbal instruction would suffice without constant reference to the sound and symbol of music. No conductor could possibly double in the role of program director. The author had sufficient amount of problems to conquer while conducting or supervising the performance. Although the earphones and chin microphone have provided means of communication with the master control, it would be impossible to engage in conversation with the recording personnel, except for exchanging brief information between the preparatory "stand-by", initial "cues", and final "cuts".

The success of sessions involving the cooperation of a music director with a program director would seem to depend on the music director's professional preparation in studio procedures, and the program director's familiarity with the problems of music. Obviously, all those preparations would be superfluous in case of borrowing the sound of performance from phonodiscs, or tapes, for their direct synchronization with notation or graphs.

The experiments in recording of notation synchronized with sound have convinced the personnel that the most satisfactory results could be obtained by direct scanning of the music copy by two cameras. The use of slides proved costly in production and cumbersome in recording. Moreover, any recording of the "second generation", instead of originals, would unavoidably result in loss of picture quality.

The direct recording of music copy could be done even in primitive lighting conditions, provided the camera operator was familiar with music notation. The optimal conditions would probably involve two music-reading camera operators, alternately scanning two uniformly printed music scores. Another suggestion could be to prepare the music copy in the same way as graphs, that is, in form of a continuous band of paper. In order to save money, one could cut up and join together sheets of paper with notation reproduced on any of the office machines. Otherwise, one would have to purchase two printed scores. Naturally, all those activities would presuppose receiving reproduction permission from copyright owners.

Synchronization of graphs or any other illustrative material would not pose any serious problems. Construction of special metal clamps, which could be mounted on the top of any table or desk, would easily substitute for any "crawler" device. Wooden dowels could serve as supply and take-up rollers for the copy which could be stretched between two clamps holding the rollers and permitting their movement by manual cranking. Those devices have been constructed by the local metal and carpenter's shops and have been used toward the end of the project. Any other more sophisticated devices could be built or adapted from a variety of teleprompters or spindles used for film rewinding.

The use of color in graph production proved desirable, though difficulties in adjustment of camera balances causing some instability in the monitor's retrieval, did not permit to reach reliable conclusions. Colors of more intense saturation, particularly dark red and brown, were difficult to retrieve accurately. Furthermore, every edge of tapes outline caused considerable diffraction of light into spectra, surrounding the tape bars with multicolored interference fringes. Changes in the power and angle of illumination did not seem to alleviate this distorting phenomenon.

Graphic Symbolization

The rationale of graphic symbolization could hardly be tested within the scope of a study to determine the feasibility of synchronization. Nevertheless, reactions of persons involved in graph production deserve brief mention. Although the first look may leave an impression of forbidding complexity, a closer acquaintance with graphs has led ultimately to a clear realization of true tonal relationships. Such was the experience of two assistants who were asked to translate the symbols of conventional notation into "Nota-Graphs". In fact, they could reverse the process by singing or playing the music symbolized in form of graphic notation. How much of this ability was reinforced by the knowledge of music they knew from conventional notation was difficult to determine.

In light of those experiences, the author would recommend testing of the system's adaptability for reading of music, preferably by separate groups of those who are familiar with the traditional notation and those who are not. Only such tests could determine whether or not graph notation is educationally desirable. The objectives could range from the general identification to the accurate performance of melodic and rhythmic patterns. Experiments in dictation could be recorded in traditional notes on a two-line staff. At all times, however, it should be remembered that this notation has not been devised to assist a performer. Its original aim was to clarify the most relevant structural principles, as manifested in the movement of pitch and duration.

As much as the first attention tends to focus itself on consecutive relations in their linear presentation, the potential of graphs to clarify harmonic relations may be overlooked. A glance at the harmonic progression from tonic to dominant in the initial measures of "Dido's Lament", reveals the distance of actual pitch intervals characteristic for every minor triad and every chord of the "dominant-seventh", respectively. Analogically, the characteristic intervals of a major triad can be visually detected as, for instance, in the final harmonies of Figures 9 and 10.[25] Some of the figures were reproduced before final corrections on the graph copy. Therefore, not all bars representing the pitches of "B", "C", or "C#" carry the clarifying ledger lines attached to them. Readers disturbed by the lack of level reference in the wide space below the "E" line or above the "G#" line--are referred to Figures 15-17 or to their colorless substitutes in Appendices A-C.[26]

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[25] Figs. 9 and 10, pp. 28-29.

[26] Figs. 15-17, pp. 33-35,
or Apps. A-C, pp. 53-55.

Following of contrapuntal imitation in Mazzocchi's Italian madrigal or in Josquin's Latin motet may prove difficult at first, especially when consulting Figures 6-7 or 8-10 as separate illustrations. This inconvenience seems to be unavoidable, whenever the field of presentation is restricted by the format of a page or of a television screen. The continuity of a moving graph makes identification somewhat easier. The playback may be stopped in order to examine the picture in detail. Prolonged stop-frames, however, may wear out the tape due to the rotating action of the recording head.

The unfolding of the total length of original bands in front or around the class, can hardly be matched by any other visual method. In lack of space, the "crawler" device may be used to advantage. Different sections of a composition may be examined and compared with each other with little delay. This method may be preferred to all other illustrations, particularly in analytical studies.

Application of Programs

Synchronization of music with notation or graphs was meant to equip the teacher with a program which could be used for various purposes in all aspects of the study of music. No attempt was made to supply the verbal commentary, running along the music, for the fear of limiting the program's application. Combinations of performance with traditional notation or arbitrary graphs were kept as separate portions on one tape reel--in order to give the instructor the freedom of choice.

Pictures of music performance would probably be selected for a class in general music or in music history. Classes in harmony, counterpoint, or analysis could profit from the view of notation or graphic presentation. Naturally, the level of instruction would have much to do with the suitability of such programs. In certain sense, the determination of program's adaptability would have to follow the same criteria as those applied to choice of textbooks, scores, and other instructional materials for different levels of instruction.

Music could be prepared to fill curricular needs from elementary school to graduate seminars. The notational section could expand to include holographs, manuscripts, period notations, etc. in relation to the authentic sound. The graphs would be found particularly serviceable in analysis of the contemporary music literature, the understanding of which is frequently hindered by inadequacies and complexities of the printed page. Some of the contemporary scores could be video taped without the necessity of translating them into graphs.

Storing of programs of this nature in libraries or instructional materials centers would provide a reservoir of reference similar to books, scores, phonograph discs, audio-tapes, films, film strips, microfilms, slides, overhead transparencies, charts, etc. The emphasis on instruction in musical form, as the best antidote against the view of music encumbered by secondary attributes or irrelevant accretions, has been frequently acknowledged as the best tool of cognitive appreciation. The proliferation of new editions of collected works, scores, anthologies, etc., seems to indicate the increasing demand for printed music as the best source of information for the student. In this regard, the synchronized video tapes may fill the same need as effectively as the scores and phonodiscs do it separately.

Electronic Video Recording

Long before the advent of the new process of Electronic Video Recording, the author has suggested in the first draft of this project's outline, that the technology of the future would eventually solve the problem of utilizing home television receivers for playbacks of prerecorded materials. Speculation as to the possibility of using the non-broadcasting channels for home assignments in music was briefly discussed in connection with the idea of creating libraries of video tapes which could be checked out to students for use at home.

Now, with the plans definitely formulated by the Columbia Broadcasting System, Inc. to produce dual-tracked miniature films, circular cartridges, and special EVR player units--the dream of a library of integrated music programs approaches reality.[27] Moreover, the nature of the new film fits the objective of synchronization of performance with notation or graphs, to perfection. One track can be occupied by pictures or performance, and the other one by pictures of notation. The sound tracks run at the edges of

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[27] The new process was announced and demonstrated by the Electronic Video Recording, a division of Columbia Broadcast System, Inc., New York, on December 10, 1968.

8

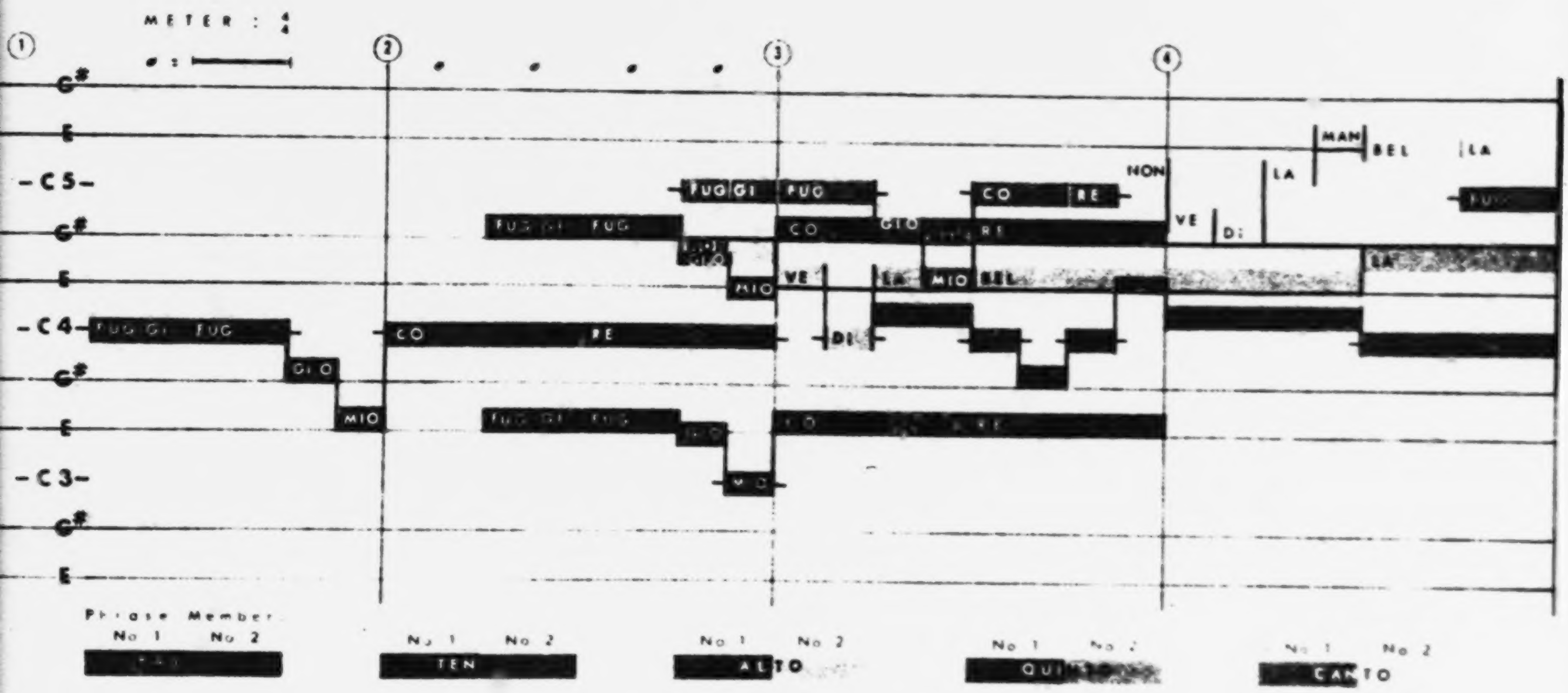
a less than 3/8" wide film. The EVR cartridge and the EVR player make it possible to convert the film into electronic impulses which feed directly into the television receiver. The EVR player unit has a simple control which permits switching from one track to the other without delay. Every single film frame can be shown in stop motion without injury to the film. The reception on the screen is exceptionally well defined.

Motion picture films or video tapes may serve as original sources from which the CBS laboratories can print the EVR films. The EVR player units will not be available on the market until Summer of 1970. The color version of the EVR player is not expected to be in production until the end of 1971. The color EVR films, however, will be single-tracked because the space of the parallel track will be utilized for color coding. Thus, synchronization of two programs in color will not be possible. Perhaps the simultaneous electronic "projection" from two separate player units on two separate television receivers with "sync" signals at the beginning of each film would be even more effective than the retrieval of one program at a time from the dual-tracked, black and white film.

The author was privileged to witness a special demonstration of the EVR films and prototypes of the new equipment at the CBS headquarters in New York. Several conferences with CBS officials and subsequent correspondence have convinced him that the EVR system offers unique opportunities in the field of educational technology and should be examined by alert music educators for its potential in music instruction.

APPENDICES A-C

(MONOCHROMATIC FIGURES 15-17)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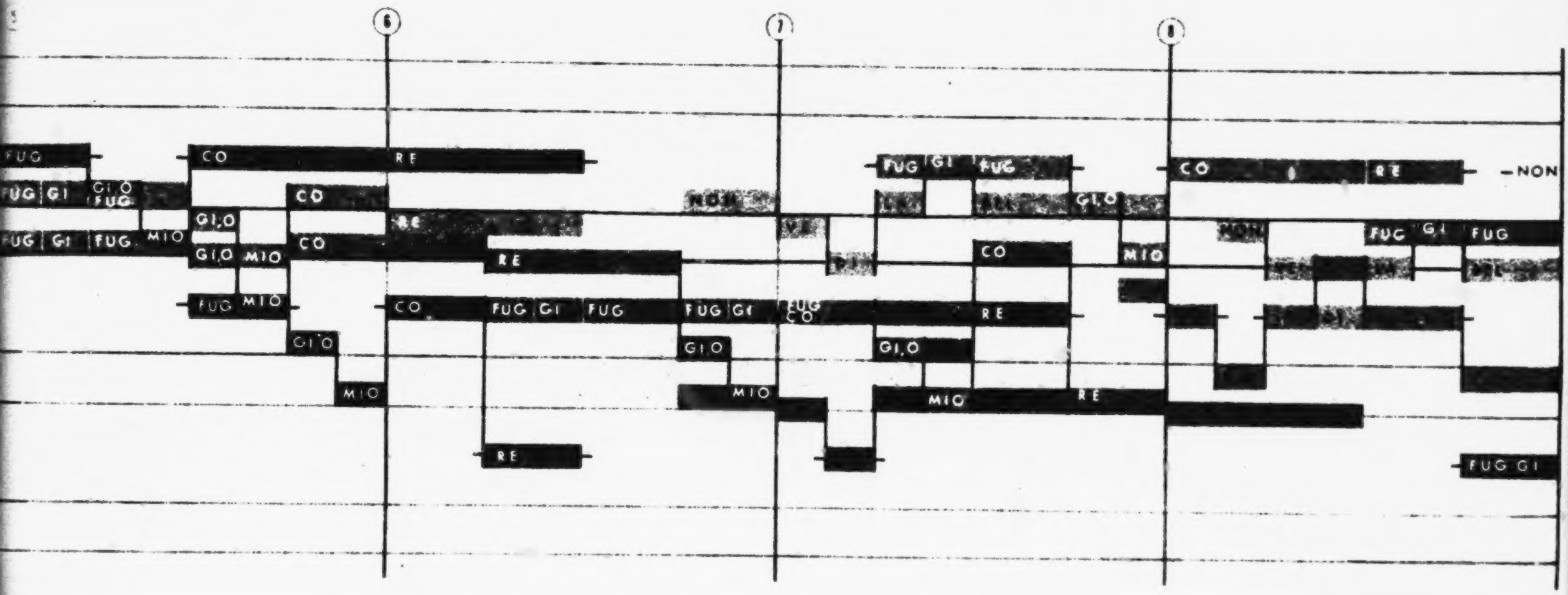
Appendix A

The Beginning of Mazzocchi's "Fuggi, Fuggi" in Color NOTA - GRAPH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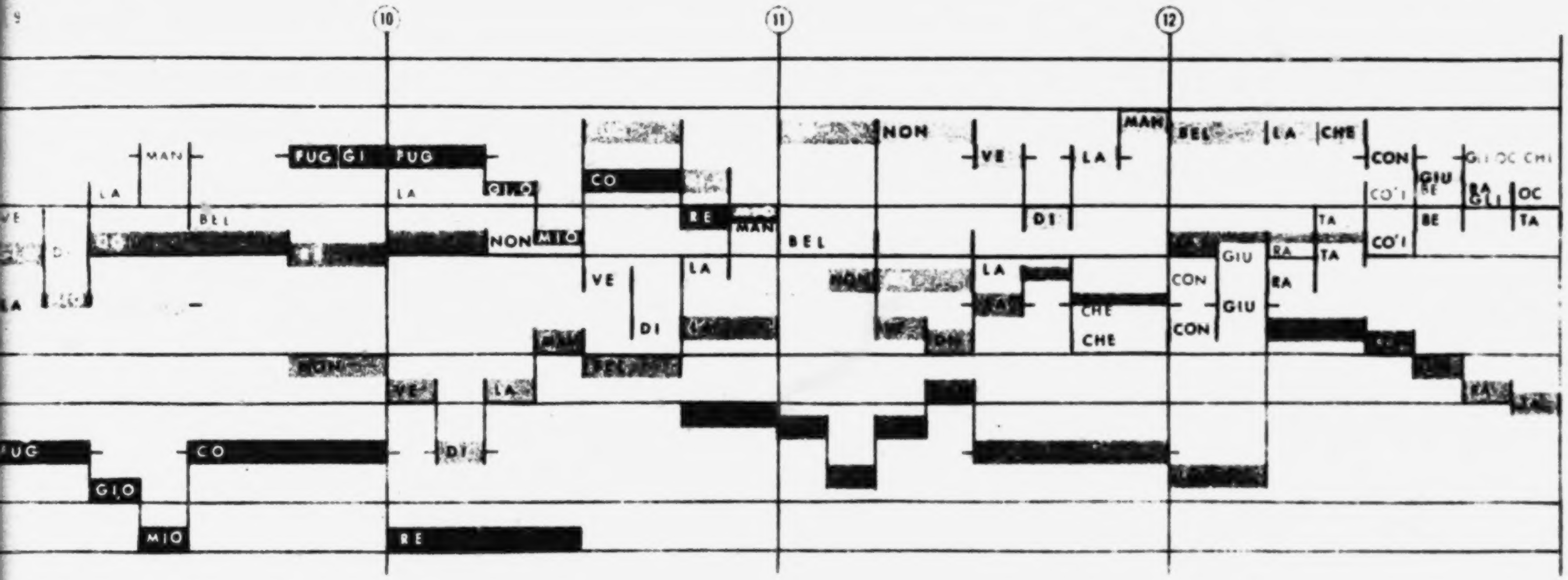
Appendix B

App. A cont. (m. 5 - 8)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Appendix C

App. B cont. (m. 9 - 12)

APPENDIX D

PROGRAM CONTENTS

(Tables 1-5)

TABLE 1

PILOT PROGRAM I (The Passacaglia) PROGRAM CONTENTS

No.	Subject	Performers	Time
	Music Selections: I "Ah, Belinda, I am prest with torment" Aria (Song) II "Thy hand, Belinda" Recitative and Aria both from the opera Dido and Aeneas by Henry Purcell (1659-1695)		
1)	Introductory Titles		1'
2)	Performance of Sel. I	Soprano with modern strings and harpsichord	4'
3)	Notation of 2)	Same as 2)	4'
4)	Performance of Sel. I	Soprano with old strings and harpsichord	4'
5)	Graph of 4)	Same as 4)	4'
6)	Performance of Sel. II	Soprano with modern strings and harpsichord	4'
7)	Notation of 6)	Same as 6)	4'
8)	Performance of Sel. II	Soprano with old strings and harpsichord	4'
9)	Graph of 8)	Same as 8)	4'
10)	Final Titles		1'
	Total Time		34'

TABLE 2

PILOT PROGRAM II (Canonic Imitation) PROGRAM CONTENTS

No.	Subject	Performers	Time
	Music Selection: "Veni, Sancte Spiritus" (Prima pars) Motet for Six Parts in Double Canon by Josquin des Pres (c1440-1521)		
1)	Introductory Titles		1'
2)	Graph of 3 Upper Parts	2 Sopranos (Discantus) 2 Altos (Contratenor)	4'
3)	Notation of 3 Upper Parts	2 Sopranos (Discantus) 1 Alto (Quinta vox) 2 Altos (Contratenor)	4'
4)	Graph of 3 Lower Parts	1 Tenor (Tenor) 2 Basses (Bassus)	4'
5)	Notation of 3 Lower Parts	1 Tenor (Tenor) 1 Tenor (Sexta vox) 2 Basses (Bassus)	4'
6)	Performance of 4 Canonic Parts	2 Sopranos (Discantus) 2 Altos (Contratenor) 1 Tenor (Tenor) 2 Basses (Bassus)	4'
7)	Graph of 6 Parts	same as 6)	4'
8)	Performance of 6 Parts	2 Sopranos (Discantus) 1 Alto (Quinta vox) 2 Altos (Contratenor) 1 Tenor (Tenor) 1 Tenor (Sexta vox) 2 Basses (Bassus)	4'
9)	Notation of 6 Parts	same as 8)	4'
10)	Graph of 6 Parts	same as 8)	4'
11)	Final Titles		1'
	Total Time		38'

TABLE 3

PILOT PROGRAM III (Vocal Free Imitation) PROGRAM CONTENTS

No.	Subject	Performers	Time
	Music Selections: I "Le Rossignol plaisant et gratieux" Chanson by Orlando di Lasso (c1532-1594) II "Fuggi, fuggi, o mio core" Madrigal by Domenico Mazzocchi (1592-1665) III "Pian piano aure tranquille" Madrigal by Domenico Mazzocchi (1592-1665)		
1)	Introductory Titles		1'
2)	Performance of Selection I	1 Soprano (Soprano) 1 Alto (Alto) 1 Tenor (Tenore primo) 1 Alto (Tenore secondo) 1 Bass (Basso)	2'
3)	Notation of 2)	same as 2)	2'
4)	Performance of Selection II	1 Soprano (Canto) 1 Alto (Quinto) 1 Tenor (Alto) 1 Alto (Tenore) 1 Bass (Basso)	3'
5)	Notation of 4)	same as 4)	3'
6)	Graph of 4)	same as 4)	3'
7)	Performance of Selection III	2 Sopranos (Canto) 1 Alto (Quinto) 1 Alto (Alto) 1 Tenor (Tenore) 2 Basses (Basso) Gamba, Lute, Harpsichord (Basso continuo)	5'
8)	Notation of 7)	same as 7)	5'
9)	Final Titles		1'
	Total Time		25'

TABLE 4

PILOT PROGRAM IV (Instrumental Free Imitation) PROGRAM CONTENTS

No.	Subject	Performers	Time
	Music Selection: The Brandenburg Concerto No. 6 (in B-flat major) by Johann Sebastian Bach (1685-1750)		
1)	Introductory Titles		1'
2)	Notation with unrealized continuo	First Viola (Viola da braccio I) Second Viola (Viola da braccio II) Violoncello (Viola da gamba I) Bass Viol (Viola da gamba II) Violoncello (Violoncello) String Bass (Violone) Harpsichord (Cembalo)	
	First mov.		7'
	Second mov.		4'
	Third mov.		6'
3)	Performance with realized continuo	same as above	
	First mov.		7'
	Second mov.		4'
	Third mov.		6'
4)	Notation with realized continuo	same as above	
	First mov.		7'
	Second mov.		4'
	Third mov.		6'
5)	Final Titles		1'
	Total Time		53'

TABLE 5

PILOT PROGRAM V (The Composite Program) PROGRAM CONTENTS

Pilot Program	Title	Excerpts from Selections	Time
I	The Passacaglia	1)"Ah, Belinda, I am prest with torment" 2)"Thy hand, Belinda" (Rec. & Aria) by Henry Purcell (1659-1695) (from the opera Dido and Aeneas)	14'
II	Canonic Imitation	"Veni, Sancte Spiritus" (Prima pars) (Motet for Six Parts in Double Canon) by Josquin des Pres (c1440-1521)	16'
III	Free Imitation (Vocal)	1)"Le Rossignol plaisant et gratieux" (Chanson) by Orlando di Lasso (c1532-1594) 2)"Fuggi, fuggi, o mio core" (Madrigal) by Domenico Mazzocchi (1592-1665) 3)"Pian piano aure tranquille" (Madrigal) by Domenico Mazzocchi (1592-1665)	17'
IV	Free Imitation (Instrumental)	The Brandenburg Concerto No. 6 (in B-flat major) by Johann Sebastian Bach (1685-1750)	12'

Total Time: 59'

APPENDIX E

PRODUCTION SYNCHRONIZATION

(Tables 6-10)

TABLE 6

PILOT PROGRAM I (Performance, Notation, Graph) PRODUCTION SYNCHRONIZATION

No.	Subject	Video	Audio	Time
1)	Title & Commentary	Slide 25	Tape Reel I/1	10"
2)	Grant Information & Music	Slide 26		10"
3)	Project Personnel	Slide 27		10"
4)	Program Credit	Slide 28		5"
5)	Production Credit	Slide 29		5"
6)	Program Division	Slide 30		5"
7)	Pilot Program	Slide 31		5"
8)	Music Selections	Slide 32		10"
9)	Notation Copyright	Slide 33		5"
10)	Graph Copyright	Slide 34		5"
11)	Part I & Commentary	Slide 35	Tape Reel I/2	10"
12)	Performance Credit	Slide 36		10"
13)	Passacaglia I (Perf.)	Film Reel I/1	Film Reel I/1	4'
14)	Part II & Commentary	Slide 37	Tape Reel I/3	10"
15)	Passacaglia I (Not.)	Slides 1-12	Film Reel I/1	4'
16)	Part III & Commentary	Slide 38	Tape Reel I/4	10"
17)	Performance Credit	Slide 39		10"
18)	Passacaglia I (Perf.)	Film Reel I/2	Film Reel I/2	4'
19)	Part IV & Commentary	Slide 40	Tape Reel I/5	10"
20)	Passacaglia I (Graph)	Graph Roll I	Film Reel I/2	4'
21)	Part V & Commentary	Slide 41	Tape Reel I/6	10"
22)	Performance Credit	Slide 42		10"
23)	Rec. & Pass.II (Perf.)	Film Reel II/1	Film Reel II/1	4'
24)	Part VI & Commentary	Slide 43	Tape Reel I/7	10"
25)	Rec. & Pass.II (Not.)	Slides 2-9	Film Reel II/1	4'
26)	Part VII & Commentary	Slide 44	Tape Reel I/8	10"
27)	Performance Credit	Slide 45		10"
28)	Rec. & Pass.II (Perf.)	Film Reel II/2	Film Reel II/2	4'
29)	Part VIII & Commentary	Slide 46	Tape Reel I/9	10"
30)	Rec. & Pass.II (Graph)	Graph Roll II	Film Reel II/2	4'
31)	Pilot Program	Slide 47		5"
32)	Title & Commentary	Slide 25	Tape Reel I/10	10"
33)	Grant Information & Music	Slide 26	Tape Reel II/2	15"

Tentative Timing: ca.: 35'40"

TABLE 7
PILOT PROGRAM II (Performance, Notation, Graph) PRODUCTION SYNCHRONIZATION

No.	Subject	Video	Audio	Time
1)	Project Title	Slide 55 I/1	Audio Tape II/1	10"
2)	Grant Information	Slide 56 II/1	Audio Tape II/2	10"
3)	Project Personnel	Slide 57 I/2	cont.	10"
4)	Program Personnel	Slide 58 II/2	cont.	10"
5)	Production Personnel	Slide 59 I/3	cont.	10"
6)	Program Division	Slide 60 II/3	cont.	5"
7)	Pilot Program	Slide 61 I/4	cont.	5"
8)	Music Selection	Slide 62 II/4	cont.	10"
9)	Notation Copyright	Slide 63 I/5	cont.	10"
10)	Graph Copyright	Slide 64 II/5	-	5"
11)	Part I	Slide 65 I/6	Audio Tape II/3	20"
12)	Graph	Graph (3U)	cont.	30"
13)	cont.	cont. (3U)	Video Tape 3	4'
14)	Performance Credit	Slide 66 II/6	-	5"
15)	Part II	Slide 67 I/7	Audio Tape II/4	20"
16)	Notation	Slides 8(1-14) II/7-II/13,I/8-I/14	Video Tape 3	4'
17)	Performance Credit	Slide 68 II/14	-	5"
18)	Part III	Slide 69 I/15	Audio Tape II/5	15"
19)	Graph	Graph (3L)	cont.	20"
20)	cont.	cont. (3L)	Video Tape 3	4'
21)	Performance Credit	Slide 70 II/15	-	5"
22)	Part IV	Slide 71 I/16	Audio Tape II/6	20"
23)	Notation	Slides 8(1-14) II/7-II/13 I/8-I/14	Video Tape 3	4'
24)	Performance Credit	Slide 72 II/16	-	5"
25)	Part V	Slide 73 I/17	Audio Tape II/7	15"
26)	Performance	Video Tape 4		4'
27)	Performance Credit	Slide 74 II/17	-	10"
28)	Part VI	Slide 75 I/18	Audio Tape II/8	10"
29)	Graph	Graph	Video Tape 4	4'
30)	Part VII	Slide 76 II/18	Audio Tape II/9	10"
31)	Performance	Video Tape 4		4'
32)	Performance Credit	Slide 77 I/19		15"
33)	Part VIII	Slide 78 I/20	Audio Tape II/10	15"
34)	Notation	Slides 8(1-14) II/7-II/13 I/8-I/14	Video Tape 4	4'
35)	Part IX	Slide 79 II/20	Audio Tape II/11	15"
36)	Graph	Graph	Video Tape 4	4'
37)	Pilot End	Slide 80 I/21	Audio Tape II/12	5"
38)	Program Titles	Slides 81-83	cont.	25"
39)	Final Credits	Slides 84-88	Audio Tape II/13	20"
	Tentative Timing:		ca.:	42'10"

TABLE 8

PILOT PROGRAM III (Performance, Notation, Graph)PRODUCTION SYNCHRONIZATION

No.	Subject	Video	Audio	Time
1)	Project Title	Slide 90 I/31	Audio Tape III/1	10"
2)	Grant Information	Slide 91 II/31	Audio Tape III/2	10"
3)	Project Personnel	Slide 92 I/32	cont.	10"
4)	Program Personnel	Slide 93 II/32	cont.	10"
5)	Production Personnel	Slide 94 I/33	cont.	10"
6)	Program Division	Slide 95 II/33	cont.	5"
7)	Pilot Program	Slide 96 I/34	cont.	5"
8)	Music Selections	Slide 97 II/34	cont.	10"
9)	Selection No. 1	Slide 98 I/35	cont.	10"
10)	Notation Copyright	Slide 99 II/35	-	10"
11)	Part I	Slide 100 I/36	Audio Tape III/3	10"
12)	Performance	Video Tape 4		2'
13)	Performance Credit	Slide 101 II/36	-	10"
14)	Part II	Slide 102 I/37	Audio Tape III/4	10"
15)	Notation	Slides 49(1-12) II/37 - I/43	Video Tape 4	2'
16)	Selection No. 2	Slide 103 II/43	-	10"
17)	Notation Copyright	Slide 104 I/44	-	10"
18)	Part III	Slide 105 II/44	Audio Tape III/5	10"
19)	Performance	Video Tape 4		4'
20)	Performance Credit	Slide 106 I/45	-	10"
21)	Part IV	Slide 107 II/45	Audio Tape III/6	10"
22)	Notation	Slides 7(1-15) I/46 - I/53	Video Tape 4	4'
23)	Part V	Slide 108 II/53	Audio Tape III/7	10"
24)	Graph	Graph	Video Tape 4	4'
25)	Selection No. 3	Slide 109 I/54	-	10"
26)	Notation Copyright	Slide 110 II/54	-	10"
27)	Part VI	Slide 111 I/55	Audio Tape III/8	10"
28)	Performance	Video Tape 4		7'
29)	Performance Credit	Slide 112 II/55	-	15"
30)	Part VII	Slide 113 I/56	Audio Tape III/9	10"
31)	Notation	Slides 9(1-22) II/56 - I/67	Video Tape 4	7'
32)	Pilot End	Slide 114 II/67	Audio Tape III/10	5"
33)	Project Title	Slide 115 I/68	cont.	5"
34)	Grant Information	Slide 116 II/68	Audio Tape III/11	10"
35)	Project Theme	Slide 117 I/69	cont.	10"
36)	Performance Credit	Slide 118 II/69	cont.	10"
37)	Titles Credit	Slide 119 I/70	cont.	5"
38)	Narration Credit	Slide 120 II/70	cont.	5"
39)	Equipment Credit	Slide 121 I/71	cont.	5"
40)	Arrangements Credit	Slide 122 II/71	cont.	5"
41)	Theme End	black	cont.	?
	Tentative Timing:		ca.:	34'55"

TABLE 9

PILOT PROGRAM IV (Performance, Notation, Graph) PRODUCTION SYNCHRONIZATION

No.	Subject	Video	Audio	Time
1)	Project Title	Slide 125 I/1	Audio Tape IV/1	10"
2)	Grant Information	Slide 126 II/1	Audio Tape IV/2	10"
3)	Project Personnel	Slide 127 I/2	cont.	10"
4)	Program Personnel	Slide 128 II/2	cont.	10"
5)	Production Personnel	Slide 129 I/3	cont.	10"
6)	Program Division	Slide 130 II/3	cont.	5"
7)	Pilot Program	Slide 131 I/4	cont.	5"
8)	Music Selection	Slide 132 II/4	cont.	15"
9)	Part I	Slide 133 I/5	Audio Tape IV/3	15"
10)	Notation Copyright	Slide 134 II/5	-	10"
11)	Performance Credit	Slide 135 I/6	-	15"
12)	First Movement	Slide 136 II/6	-	5"
13)	Notation(basso cont.)	Slides 50(1-33) I/7 - I/23	Video Tape 6(341-450)	7'
14)	Second Movement	Slide 137 II/23	-	5"
15)	Notation	Slides 50(34-45) I/24 - II/29	Video Tape 6(150-235)	5'
16)	Third Movement	Slide 138 I/30	-	5"
17)	Notation	Slides 50(46-78) II/30 - II/46	Video Tape 6(235-341)	6'
18)	Part II	Slide 139 I/47	Audio Tape IV/4	10"
19)	First Movement	Slide 140 II/47	-	5"
20)	Performance	Video Tape 6(341-450)		7'
21)	Second Movement	Slide 141 I/48	-	5"
22)	Performance	Video Tape 6(150-235)		5'
23)	Third Movement	Slide 142 II/48	-	5"
24)	Performance	Video Tape 6(235-341)		6'
25)	Part III	Slide 143 I/1	Audio Tape IV/5	10"
26)	Notation Copyright	Slide 144 II/1	-	10"
27)	First Movement	Slide 145 I/2	-	5"
28)	Notation(hrps.cont.)	Slides 51(1-32) II/2 - I/18	Video Tape 6(341-450)	7'
29)	Second Movement	Slide 146 II/18	-	5"
30)	Notation	Slides 51(33-42) I/19 - II/23	Video Tape 6(150-235)	5'
31)	Third Movement	Slide 147 I/24	-	5"
32)	Notation	Slides 51(43-73) II/24 - II/39	Video Tape 6(235-341)	6'
33)	Pilot End	Slide 148 I/40	Audio Tape IV/6	5"
34)	Titles	Slides 149-151	cont.	25"
35)	Credits	Slides 152-156	cont.	30"

Tentative Timing: ca.: 58'10"

TABLE 10

PILOT PROGRAM V (Superposition, Split-Screen) PRODUCTION SYNCHRONIZATION

Step No.	Pilot Program	Production Sync.		Program Index		Time
		VTR 1	VTR 2	VTR 1 (Master)	VTR 2 (Dub)	
1)	Crd.1-6					1'
2)	I		1-12		1)333(1)	1'
3)			22-24		4)488(P-III)	
4)		28	25	5)551(G-IV)		4'
5)		30-32		6)608(P-V)		
6)		33	36		7)662(N-VI)	4'
7)			38-40		8)712(P-VII)	
8)		44	41	9)770(G-VIII)		4'
9)	II	1- 9		1)333(I)		1'
10)		11-13		2)356(G-I)-		2'
11)			16		3)427+(N-II)	2'
12)		18-20		4)491(G-III)-		2'
13)			23		5)551+(N-IV)	2'
14)		25-26		6)608(P-V)-		1'
15)			29		7)664(G-VI)-	1'
16)			30-32		8)715(P-VII)	
17)		34		9)768(N-VIII)		4'
18)	III	1- 7		1)333(I)		1'
19)		11-13		2)357(P-I)		2'
20)		16-18		4)430(P-III)		
21)		24		6)521(G-V)		
22)			22		5)478(N-IV)	3'
23)		25-29		7)566(P-VI)		5'
24)		30-31		8)639(N-VII)		5'
25)	IV	1-12		1)000(I)		1'
26)		13		2)029(N-I)-		
27)			20		3)362(P-II)-	2'
28)			21-22		3)470(P-II)	
29)		15		2)174(N-I)		4'
30)		25-26		4)622(N-III)		
31)		32	23-24	4)772+(N-III)	3)538+(P-II)	3'
32)		33-42		5)861(F)		1'

ca.: 56'

Tentative Timing:

APPENDIX F

PROGRAM EVALUATION

(Tables 11-22)

TABLE 11
QUESTIONNAIRE FORM

(1)

Check every appropriate circle, even if more than one apply in one row.

1) I have viewed Pilot Programs: I (1) ○ II (2) ○ III (3) ○ IV (4) ○

2) I am responding as a member of: Educational Institution (1) ○ Government Agency (2) ○ Communications Industry (3) ○ Other Profession (4) ○

3) University or College (1) ○ Secondary School (2) ○ Elementary School (3) ○ Other School (4) ○

4) Administration or Staff (1) ○ Faculty (2) ○ Student (3) ○

5) General (1) ○ Curriculum (2) ○ Library (3) ○ Other (4) ○ Full-Time (5) ○ Part-Time (6) ○ Undergraduate (7) ○ Graduate (8) ○

6) I consider myself a Music: Layman (1) ○ Administrator (2) ○ Educator (3) ○ Performer (4) ○ Student (5) ○

7) Theory or Composition (1) ○ Literature or History (2) ○ Applied Music (3) ○ Teacher Training (4) ○ Other Music (5) ○

8) I consider myself a Communications: Consumer (1) ○ Professional (2) ○

9) Television (1) ○ Film (2) ○ Radio (3) ○ Audio-Visual (4) ○ Other (5) ○

10) Executive (1) ○ Educator (2) ○ Performer (3) ○ Employee (4) ○ Other (5) ○

TABLE 12
QUESTIONNAIRE FORM

(2)

11) Pilot Programs (without preliminaries) are:	too long (1) ○	too short (2) ○	just right (3) ○

12) Music selections are suitable for:	class use (ITV) (1) ○	home use (EVR) (2) ○	Music Lit. (3) ○	Music Hist. (4) ○	Music Theory (5) ○	Music Performance (6) ○

13) Music selections are compatible with:	Elementary Curriculum (1) ○	Secondary Curriculum (2) ○	College Curriculum (3) ○	Graduate Study (4) ○	
	General Music (5) ○	Specialized Music (6) ○	Student Teaching (7) ○	Music Laymen (8) ○	Music Readers (9) ○

14) Similar tapes should be made available as:	Library Materials (1) ○	Curriculum Materials (2) ○	Home Assignments (3) ○

15) I would recommend further experimentation with the production of this type of programs:	Yes (1) ○	No (2) ○

Kindly write Arabic numerals above the dotted lines, according to the following common evaluation system: Exceptional=3, Acceptable=2, Unacceptable=1

Pilot Programs:	I	II	III	IV
16) The Sound Quality of Performance is:	.....	.....	.....	.....
17) The Sound Quality of Narration is:	.....	.....	.....	.....
18) The Visual Quality of Performance is:	.....	.....	.....	.....
19) The Visual Quality of Notation is:	.....	.....	.....	.....
20) The Visual Quality of Graphs is:	.....	.....	.....	.....
21) The Visual Quality of Titles is:	.....	.....	.....	.....
22) The Performance Quality of Music is:	.....	.....	.....	.....
23) For aesthetic reasons programs are:	.....	.....	.....	.....
24) For pedagogical reasons programs are:	.....	.....	.....	.....
25) For technical reasons programs are:	.....	.....	.....	.....

TABLE 13
TABULATION OF QUESTIONNAIRE RETURNS (1)

Check every appropriate circle, even if more than one apply in one row.

(7 Respondents)

	I	II	III	IV
1) I have viewed Pilot Programs:	(7)	(7)	(7)	(7)

	Educational Institution	Government Agency	Communications Industry	Other Profession
2) I am responding as a member of:	(7)	(0)	(1)	(0)

	University or College	Secondary School	Elementary School	Other School
3)	(7)	(0)	(0)	(0)

	Administration or Staff	Faculty	Student
4)	(3)	(4)	(0)

	General	Curriculum	Library	Other	Full-Time	Part-Time	Under-Graduate	Graduate
5)	(0)	(1)	(0)	(2)	(2)	(2)	(0)	(0)

	Layman	Administrator	Educator	Performer	Student
6) I consider myself a Music:	(3)	(1)	(1)	(1)	(0)

	Theory or Composition	Literature or History	Applied Music	Teacher Training	Other Music
7)	(1)	(0)	(1)	(2)	(0)

	Consumer	Professional
8) I consider myself a Communications:	(1)	(4)

	Television	Film	Radio	Audio-Visual	Other
9)	(4)	(3)	(3)	(4)	(0)

	Executive	Educator	Performer	Employee	Other
10)	(1)	(3)	(1)	(0)	(0)

TABLE 14

TABULATION OF QUESTIONNAIRE RETURNS (2)

11) Pilot Programs (without preliminaries) are:

too long	too short	just right
(3)	(0)	(4)

12) Music selections are suitable for:

class use (ITV)	home use (EVR)	Music Lit.	Music Hist.	Music Theory	Music Performance
(7)	(3)	(4)	(5)	(4)	(3)

13) Music selections are compatible with:

Elementary Curriculum	Secondary Curriculum	College Curriculum	Graduate Study
(0)	(3)	(7)	(4)

General Music	Specialized Music	Student Teaching	Music Laymen	Music Readers
(7)	(5)	(3)	(4)	(4)

14) Similar tapes should be made available as:

Library Materials	Curriculum Materials	Home Assignments
(7)	(6)	(2)

15) I would recommend further experimentation with the production of this type of programs:

Yes	No
(7)	(0)

Kindly write Arabic numerals above the dotted lines, according to the following common evaluation system:Exceptional=3,Acceptable=2,Unacceptable=1.

Pilot Programs:	P[1]/R[2]/A[3]	P[1]/R[2]/A[3]	P[1]/R[2]/A[3]	P[1]/R[2]/A[3]
16) Sound of Performance:	12/7/1.71	15/7/2.14	15/7/2.14	15/7/2.14
17) Sound Narration:	12/5/2.40	12/5/2.40	12/5/2.40	12/5/2.40
18) Visual Performance:	7/5/1.40	8/5/1.40	8/5/1.60	8/5/1.60
19) Visual Notation:	11/6/1.83	11/6/1.83	11/6/1.83	11/6/1.83
20) Visual Graphs:	16/7/2.29	16/7/2.29	16/7/2.29	16/7/2.29
21) Visual Titles:	10/7/1.43	11/7/1.57	11/7/1.57	11/7/1.57
22) Performance Quality:	11/5/2.20	11/5/2.20	11/5/2.20	11/5/2.20
23) Aesthetic reasons:	12/5/2.40	12/5/2.40	12/5/2.40	12/5/2.40
24) Pedagogical reasons:	14/5/2.80	14/5/2.80	14/5/2.80	14/5/2.80
25) Technical reasons:	8/5/1.60	9/5/1.80	9/5/1.80	9/5/1.80

---

[1] Total of Points

[2] Number of Respondents

[3] Average Points

TABLE 15

EVALUATION BY A MUSIC EDUCATOR

Enclosed with this letter is the questionnaire form filled out as completely as I am able to at this time. Since the questionnaire does not permit as complete an expression as I should like to make, I am going to amplify it by means of this letter.

For a pilot project your study was an ambitious one, indeed. I am utterly amazed at both the quantity and quality of work that you have been able to do on the limited budget of money and time available through the project grant. Certainly the idea of synchronizing the sound of music with the symbols that represent it is valid. In my opinion, you have also shown by the work you have accomplished that it is also feasible.

The most significant single contribution that your study makes is the development of the moveable graph. This gives a visual representation of the music as it is heard much more clearly than conventional notation. The graph has a great deal of pedagogical significance for the musical scholar as well as the music novitiate.

It was a pleasure meeting with you and the other members of the evaluation team. I congratulate you upon a job well done and wish for you every possible success in the future.

Keith D. Snyder, Associate Dean
School of Fine and Applied Arts
California State College at Los Angeles
October 8, 1968

TABLE 16
EVALUATION BY A MUSIC ADMINISTRATOR

I am deeply impressed by the amount of work produced under a minimal budget and in a very short time. The quality of the pilot tapes in terms of concept and performance is high. They are technically marred by the many hazards of amateur production without adequate studio facilities, and by the imperfections and unreliability of equipment. The graphs are impressive and revealing. The technique of presenting the printed music needs improvement. The performances, though flawed, indicate how meaningful and effective the medium can be. The sound reproduction is much better than that from an optical sound track for motion pictures.

All of these criticisms can be readily overcome with more time and experience, an adequate production budget, and better technical resources.

The introductory talk should be severely curtailed or eliminated. The essential material and approach should be introduced immediately. As a proposal, a composite presentation of each selection using all visual devices (musicians, notation, graphs, individualization, split-screen, overlaps and dissolves, etc.) could well emphasize (without verbalism) the intimate interrelation of sound, symbol and performance. Credits should be reserved for the end.

Any form of lecturing (beyond essential announcing which is not merely the reading of subtitles) should be avoided in this medium if a direct, unmediated presentation is possible.

The graphic representation of the contrapuntal pieces is particularly effective--indeed, it seems to me the core of the project, the feature around which the whole presentation should revolve. It is meaningful to composer, analyst, performer and layman, Even those with no knowledge of notation can recognize the relation of the graphs with the sound. This alone would justify another grant to produce the whole proposed series.

These tapes could be extremely useful at all college levels, and perhaps in secondary schools to some degree. They should however be broken up into a larger number of shorter tapes to increase utility. I would limit tapes to 1/2 hour.

I strongly urge continuation of the project and preparation of a library of tapes to be made generally available.

Gerald Strang
Professor of Music
California State College at Long Beach
Long Beach, California
October 6, 1968

TABLE 17

EVALUATION BY A MUSIC PERFORMER

The graphs are very outstanding both for the musician and the layman. I think the graphs are especially useful in the presentation of contrapuntal or chamber music. They are easy to follow and are extremely meaningful. In fact they are the most unique part of this program.

The notation is difficult to read due to the camera delay in following the musical score.

I suggest you try for a more theatrical approach to the presentation. The audience is naturally going to compare these video tapes with the usual TV programs. The cameras should be on the "active" performers (not those who have just finished). More visual activity is needed for interest during the performances. More professional detailing is needed. The titles need improving.

The performances certainly need more rehearsal time with the best musicians in a professional studio. If possible the engineers who work with this project need to be musicians.

But I think the results of this research project are remarkable especially working with such a limited budget. The project should be pursued by all means, as such video tapes would be valuable for many students making serious studies of music.

Eileen K. Strang
6500 Mantova Street
Long Beach, California
October 6, 1968

TABLE 18
SUBSIDIARY REPORT

The basic concept and thrust of this project is quite useful, especially in the study of music on the college level. The approach suggested by this study offers a new kind of measuring stick in examining the artistic logic of music. Although the production values, such as camera work, need improvement, the potential of this new approach is well worth the work involved.

More selectivity is needed in utilizing picture and sound. The visual medium calls for selectivity and videotapes of this project ought to fit in this convention or limitation. There seems to be too much music to make a particular point. Perhaps this could be achieved with a more professional production crew pulling all the loose ends together.

These tapes can be useful on the college and secondary levels, but they should be broken down into shorter time units. For example, no one tape should be more than 12 minutes in length. Each tape should be designed to present a particular feature, as if it were modular in concept.

Perhaps in the future videotapes might be recorded in color to do the following:

1. Highlight important information or problem areas to be resolved.

2. Increase information intake by viewers through color association.

In addition, the use of color might sustain the attention span of the viewer, especially with the details being visualized on the screen.

It is significant that this particular project avoided cluttered-complex visuals. I support the idea that an economy of line and picture is essential to maximize television concentration. The finished product as designed by Dr. Skapski would serve as a vital resource for music instructors.

I strongly urge the continuation of the project and look forward to further efforts in this area.

Bertram Barer,
Director, Radio-TV-Film Department
San Fernando Valley State College
Northridge, California.
February 19, 1969

TABLE 19

SUBSIDIARY REPORT

(1)

The greatest prospect for effective utilization of these programs lies in the potential of individualized or automated learning. Without bothering with mechanical equipment or technological details, I would envision a system encompassing the data contained in these programs along with data from myriads of other programs in other disciplines made available to the student. Based on guidance provided by the professor, he moves through a series of meaningful experiences which he alone controls. This kind of supplemental enrichment will provide the student with immeasurable motivation and stimulus and prompt him to keep reaching for newer academic goals.

In education today we are dealing with systems which require a great deal of human handling of retrieval equipment. Motion picture set-ups, television recording equipment, playback equipment through monitors--all require what would be best described as "non-automated" discrimination. These physical and administrative details required in handling the message to the point of retrieval are a great drain on the patience and stamina of the average professor and student.

The motion picture with magnetic sound track system seems to be the recording and retrieval medium that provides the best possible fidelity of reproduction up to now. I believe that this basic system should be used to preserve these teaching programs, since it is the most stable medium known and will allow for departure to automation through electronic/video systems, individualized learning through custom user demands, and complete compatibility with the majority of classroom retrieval equipment in existence today.

To predict any degree of success for a project of this nature is impossible. This statement might be explained and qualified by saying that the basic nature of the material being presented in these programs is incorruptible. The method of retrieving the information in the suggested format provides for the success or failure of the program. Too often, the significance of a learning program is evaluated with respect to the medium in which it is presented rather than the raw, basic nature of the program itself.

TABLE 20

SUBSIDIARY REPORT (2)

The principle of audio/visual presentation--simultaneous communication of sight and sound stimuli--has been applied effectively here. Most of the discussion involved in evaluating the worth of this program must revolve around the concepts of music theory, performance and style.

In practically every technical phase of this experimental program, we have seen some degree of failure in one or more of the recording and/or retrieval systems. Unavoidably, these failures are a vital part of the experimental nature of the development of this system.

In addition to experimentation in applying this program to existing recording and retrieval systems, it must be remembered that potentially there are new, undiscovered systems waiting to be used. Technological advances are providing new avenues for presenting this kind of program. In searching for the "ultimate" channel of communication, the same criteria and objectives apply in evaluating the new system: will it allow the material to be presented with little or no interruption, discoloration, static or change in the message?

Merwin E. Soyster
Director, Educational Resource Center
San Fernando Valley State College
Northridge, California
February 18, 1969

TABLE 21

SUBSIDIARY REPORT

(1)

I have been associated with the professional audio aspects of education for the last ten years. This includes the use of Ampex 300 Series recorders, Altec power distributions systems and professional disc recording systems. This project was my first venture into combining closed circuit television with professional audio procedures of music recording. I have also had experience in 16 and 35 mm. full coat sprocketed film which was employed in the first Pilot Program.

When I was first approached by Dr. Skapski in regard to this project, I was in the process of collecting information on closed circuit television systems for the Fine Arts Department. I was evaluating 1" and 1/2" helical scan recorders, taking in picture and audio quality, facility of operation, machine interchangeability, as well as cost. My investigation included inquiries to other educational facilities in the Los Angeles area. I discovered that the majority of facilities were using 1" Ampex machines, ranging from the Model 5000 through the Model 7800. Dr. Skapski and I discussed at some length the intended application of this series of programs. Combining the requirements of both studies, I decided on the Ampex 1" format for the following reasons:

1) Known quality of Ampex professional audio equipment;

2) Interchangeability of tapes between models in the line, from the lowest priced Model 5000 at $950.00 to the Studio Broadcast Model 7800 at $15,000, and

3) The editing and inserting capabilities electronically, without cutting of the tape.

It was this editing facility that greatly assisted Dr. Skapski in expanding the scope of the format with the limited grant budget. With the funds available, it was apparent that the equipment would have to be rented, rather than purchased.

We investigated the possibility of using the facilities of the local television studios, but found that the cost of major network studios was well beyond the budget of the grant. We were referred to Ward-Davis Associates, in Pasadena; and although they had limited facilities, the equipment was of semi-professional quality; i.e., cameras were 800 line Ampex 1" Vidicon cameras tied to Ampex 7800 machines, with electronic editing and Conrac monitors and mixing facilities.

TABLE 22

SUBSIDIARY REPORT (2)

Due to the problem of one of the major performer's leaving on an extended opera tour, it was necessary to begin Pilot Program One at once. Because of the time limit we were unable to obtain studio time for video taping. We were advised, however, that a 16 mm. film synchronized with 16 mm. full coat sound would be transferable to 1" video tape with reasonable cost and quality. This we did. However, when the transfer was attempted there was a considerable loss of picture quality, as well as sound quality. This was attributed to the small format of 16 mm. film and the audio frequency range of only 8000 cycles with an optical track, as compared to a possible 15,000 cycles on the magnetic video tape.

Once again, limited funds forced the abandonment of plans to use an electrical crawler for graphic displays. Instead, a makeshift manual crawler was devised from a overhead projector, Model #3651, made by American Optical Co. This resulted in the jerky movement of some of the graphic displays. During the presentation this introduced timing errors into the synchronization schedule. In later programs with multiple overlaps, this timing error was amplified. The cross fade of the notation material was accomplished using two Kodak AV-900 Carousel slide projectors, in conjunction with a Kodak Model #1 Dissolve Control.

I feel a great deal has been gained from this project, both from the point of technical procedures and in programming for production. I also feel that the program should be expanded to a professional level of production, justified by the positive response we have received.

John Bartley
Supervisor, Recording Services
San Fernando Valley State College
Northridge, California
February 17, 1969

APPENDIX G

ERIC REPORT RESUME

DEPARTMENT OF HEALTH EDUCATION AND WELFARE
OFFICE OF EDUCATION
ERIC REPORT RESUME

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Identifiers
607 PALM--Principles of Artistic Logic in Music
608 NOTA-GRAPHS--Diagrammatic System of Music Notation
609 AMPEX Video Tape Recorders (Model No. 7800)
610 EVR-CBS--Electronic Video Recording: Division of Columbia Broadcasting System, Inc.
611 WARD/DAVIS Associates; Recording Studios, Pasadena, Cal.
612 BELL-HOWELL--Color Video System
613 CHART-PAK--Pressure Sensitive Tapes

Abstract

A study describing the methods, systems, and procedures, utilized for the purpose of recording musical performances and synchronizing their sound with related visuals of corresponding music notation and special graphs in the medium of video tape. An account of preliminary activities leading to determination of the scope, format, and contents of five pilot programs ranging from 25 minutes tc one hour in duration. Systematic description of methods used to prepare music and graph copies for video taping. A detailed report on diverse procedures used to synchronize notation and graphs with the sound of previously recorded musical performance. An evaluation of the results obtained and of possible applications of programs of similar nature in the field of music instruction. Recommendations for the future with regard to the recent developments in educational technology. The report consists of three chapters preceded by a summary and includes twenty-two tables containing technical reference material with tabulated questionnaire returns and with brief subsidiary reports by the project's associates and outside evaluators. The text is illustrated by seventeen pictorial reproductions of special graphs and music notation.